Labor Market Recoveries Across the Wealth Distribution

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Abstract

This paper studies why, in the aftermath of recessions, low-wealth workers experience larger falls and slower recoveries in earnings than high-wealth workers. I show that differences in job-switching and job-losing rates play an important role in explaining these earnings dynamics. I build a macro model of the labor market that includes a novel ingredient, which I document and quantify empirically: when workers switch to new jobs they suffer a 6.4 percentage point increase in their job-loss probability over the first fifteen months at the new job. Through this model I conclude that cyclical differences in job-switching and job-losing by wealth, which the model can endogenously reproduce, explain 42 percent of the gap in earnings between low- and high-wealth workers following the Great Recession. Furthermore, the model is consistent with the sudden increase in job-switching that the US labor market experienced following the Pandemic recession, suggesting that generous government stimulus played a sizable role in the recovery.

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1 Introduction

Low-wealth workers tend to experience worse and longer lasting labor market downturns than high-wealth workers. After the Great Recession, for instance, workers with below median wealth experienced on average roughly a 7% decline in earnings, a fall that took almost four years to recover. In contrast, workers with above median wealth experienced on average only a small and short-lasting drop in earnings. In other words, the workers who suffer the worst consequences of recessions are also those worst prepared to confront them.

A recent macroeconomic literature speaks to this heterogeneity in labor market outcomes by documenting large differences in the rates at which workers flow across employment and unemployment. At the same time, there is a considerable body of work arguing for the importance of wealth in individuals' labor market decisions. Despite this, the mechanisms through which wealth affects aggregate labor market flows and the broader macroeconomic effects of this are still not well understood.

This paper identifies differences in the job-switching and job-losing rates as major contributors to the deeper and more prolonged fall in earnings experienced by low-wealth workers relative to high-wealth workers following recessions. I empirically document that workers who switch to new jobs experience a persistent increase in their risk of job-loss and build a model with this ingredient at its core.[1] This assumption gives rise to novel forces which, together, enable the model to (i) explain the cyclical differences in the job-switching and job-losing rates across the wealth distribution, (ii) explain 42 percent of the observed earnings gap between workers in the top and bottom halves of the wealth distribution following the Great Recession, and (iii) provide a rationalization to the Great Resignation that affected the US economy in the post-Pandemic period through the generous fiscal support received by households.

The main novel force the model gives rise to is the *precautionary job-keeping motive* which implies that low-wealth workers are, *ceteris paribus*, less willing to switch jobs in order to avoid the risk of job-loss that switching entails. Because job-switches are associated with earnings increases, this motive hinders the earnings recovery of low-wealth workers. In addition, the dynamic selection forces of the model give rise to a *tenure-wealth correlation* making low-wealth workers more exposed to job-loss because of the lower tenure jobs these workers tend to occupy. This leads to a labor market recovery that is interrupted by relatively more frequent unemployment spells for low-wealth workers, in turn depressing their earnings growth relative to that of high-wealth workers.

[1] I provide a simple microfoundation for this downward-sloping job-loss probability in tenure following the work of Jovanovic (1979) in which worker and firm learn about the quality of their match.

I present novel empirical facts that motivate the development of this theory. First, I show that the standard deviations of the cyclical components of the job-switching and job-losing rates at the bottom half of the wealth distribution are twice as large as those at the top half of the wealth distribution. Second, the job-switching rate is also more persistent at the bottom of the wealth distribution. In other words, after a recession hits, the rate at which low-wealth workers switch jobs falls by more and takes longer to recover relative to the rate for high-wealth workers; the rate at which low-wealth workers lose their jobs increases by more than the rate for workers with high wealth. To establish these facts, I use the Survey of Income and Programs Participation (hereafter SIPP), a representative survey of US individuals that contains rich information on respondents' labor market histories and their financial wealth.

I next develop a model that, unlike standard models of the labor market, can speak to these empirical facts. This model integrates an incomplete markets, heterogeneous agent framework into a search and matching model à la Diamond (1982) and Mortensen and Pissarides (1994) (hereafter DMP). At the heart of this model is the key assumption that I previously highlighted: when workers switch jobs they face a persistent increase in probability of job loss.

While it is well documented (e.g. Martellini, Menzio and Visschers (2021)) that workers starting a job out of unemployment initially face a high probability of losing their job that falls as the worker gains tenure at the job, I document that a similar pattern holds for workers switching from one job to another. In other words, workers who switch jobs face a higher probability of losing their jobs than they would have had they not switched in the first place.

But just how big is the risk faced by workers starting a new job? To determine the additional risk of job-loss that job-movers face I run an event study similar to that of Davis and Von Wachter (2012). I find that the increase in job-loss probability due to job-switching is 6.4 percentage points in the first fifteen months at a new job. That is, workers who move from an old job to a new one are 6.4 percentage points more likely to suffer an unemployment spell in the fifteen months following the switch than they would have been had they not switched jobs in the first place. Even at the low end this estimate is economically significant given that the typical US worker has, over the same fifteen month period, an 18 percent chance of being laid-off.

In addition to an increased job-loss probability after job switches, two more ingredients are crucial for the model to deliver the cyclical moments of the job-switching and job-losing rates across the wealth distribution: workers accumulate assets, and they are risk averse. While these two assumptions are completely standard in macroeconomics, they are seldom made by the search and matching literature for technical convenience. Furthermore, the few papers that have considered these (Krusell, Mukoyama and Şahin (2010) is an early example), do not incorporate job-switches. The model I develop is the first in the search and matching literature to incorporate on-the-job search in an environment with curved utility and asset accumulation.

Novel Mechanisms. With these three key ingredients the model gives rise to the two forces that allow it to match the empirical distributional variation in the cyclical component of the job-switching and job-losing rates. The first, which I denote the *precautionary job-keeping motive*, delivers moments for the job-to-job transition rate in line with the data. This force is a causal mechanism that, simply put, makes low-wealth workers more conservative in their job-switching decisions because they are less willing to bear the risk that switching entails. While high-wealth workers can rely on their assets to get by in periods of unemployment, this is not an option for workers with low wealth. This implies that, even if offered a higher-paying job, a low-wealth worker will be less willing to accept it because they may not be able to face the higher probability of falling into unemployment.

To establish the empirical relevance of precautionary job-keeping I once again rely on the SIPP. Cross-sectional evidence from these data allows me to verify that workers with higher wealth-to-income ratios are indeed more likely to switch jobs. Furthermore, the data show that an increase in wealth has larger effects on the propensity to switch jobs at the bottom than at the top of the wealth distribution. This is in line with the model which, because of curved utility, implies that the same percent change in wealth has a drastically larger effect on the job-switching behavior of low-wealth workers than high-wealth ones. These reduced form results are consistent with the findings from a recent experiment in which some individuals in Stockton, California randomly received monthly payments for $500. West et al. (2021) provide preliminary evidence suggesting that workers who received the transfer were more likely to take on risk to improve their labor market prospects, in particular, they were willing to quit their job to accept and search for new positions.

Because recessions lead to loss of wealth and make workers more sensitive to risk, precautionary job-keeping is exacerbated during recessions, particularly for workers with low wealth. The asymmetric sensitivity to the precautionary job-keeping motive across the wealth distribution explains why the cyclical component of job-switching is more volatile for low-wealth workers. Additionally, because wealth is slow to recover, precautionary job-keeping also explains why the job-switching rate recovers more slowly for these workers.

Additionally, the dynamic selection forces of the model gives rise to a force I denote the *tenure-wealth correlation* which reconciles the empirical moments on the cyclicality of the job-losing rate across wealth. Unlike precautionary job-keeping, which underscores a causal relationship between wealth and workers' labor market decisions, the tenure-wealth correlation results from the model's equilibrium forces. Simply put, the tenure-wealth correlation is the tendency of low-wealth workers to occupy low-tenure jobs, making them more likely to suffer a string of unemployment spells following recessions. After a recession, the large pool of unemployed, most of whom are low-wealth, slowly re-enter the labor market taking up new, low-tenure positions. This leads low-wealth workers to occupy a disproportionate share of low-tenure jobs that are more likely to lead to job loss. In turn, this implies that the overall job-loss probability for low-wealth workers increases by more than for high-wealth workers. As a consequence, low-wealth workers suffer more frequent unemployment spells which contribute to their relatively depressed earnings.

Main results. The first measure of the model's success is in its ability to match the different cyclical behavior the job-switching and job-losing rates display across the wealth distribution. Unlike standard models of the labor market, this model delivers the higher volatility these rates exhibit at the bottom of the wealth distribution.

The second success of the model is that it provides two new and quantitatively important channels to understand why, after recessions, earnings fall more and recover more slowly for low-wealth workers. Because of the precautionary job-keeping motive, low-wealth workers become more hesitant to switch to new jobs following recessions. While this spares these workers additional risk of job-loss, it also prevents them for accepting better, higher-paying jobs, and ultimately slows down their earnings recovery. Because of the tenure-wealth correlation, workers with low wealth are more exposed to unemployment risk after recessions. This makes low-wealth workers cycle between low-tenure jobs and unemployment, limiting their participation in the labor market and preventing them from reaching higher-paying jobs. The model implies that these two phenomena can explain 42 percent of the gap in the earnings recovery experienced by low-wealth workers relative to high-wealth ones following the Great Recession.

The third success of the model is that it provides one possible rationalization of the phenomenon that has come to be known as the "Great Resignation," the large spike in quits and job-switches that the US has experienced since the end of the Pandemic Recession. While the Great Resignation has taken policymakers and analysts by surprise, my model shows that it can be explained through the large rounds of fiscal stimulus that accompanied the recession. According to the model, an injection of wealth in the economy alleviates the precautionary job-keeping motive, pushing more workers, especially low-wealth ones, to switch jobs. This is exactly what the data show: a large infusion of cash on worker's balance sheets followed by a jump in job-switching. Using the quantitative model, I determine that, if the government had not delivered the fiscal stimulus, the Great Resignation would not have occurred: the job-switching rate would have dropped by an extra 20 basis points at its trough, and even by the end of 2021, it would not have fully recovered.

Placement in the literature. This paper makes significant contributions to four strands of the literature. First, it contributes to the work studying labor markets over the business cycle. For decades now, researchers have sought to build models that can explain the cyclical properties of labor market indicators. As Shimer (2005) famously points out, this can be challenging for the DMP model, the workhorse macroeconomic model of the labor market. Many of the models that have made advances in matching cyclical labor market moments have introduced various degrees of heterogeneity. My paper pushes this further by including rich heterogeneity in a setting with on-the-job search. Importantly, my paper moves away from the complete markets setup popularized by Merz (1995) and Andolfatto (1996) and instead develops a business cycle model of the labor market with job-switching and uninsurable idiosyncratic risk.

While some papers can claim success in matching the cyclical properties of labor market rates, no model has seriously been able or even attempted to match the cyclical properties of these rates across the wealth distribution. This paper does exactly that: it matches not only the mean but also the variance of the job-switching and job-losing rates across wealth. Doing so is crucial to understand the differential labor market outcomes of workers following recessions.

Krusell et al. (2017) successfully match the aggregate means and variances of labor flows across employment, unemployment, and non-participation. In fact, their model can capture the means of these rates across the wealth distribution. I go beyond their work in two respects. The first is by matching not only the means but also higher moments of the job-switching and job-separation rates across the wealth distribution. The second is by doing this in a full general equilibrium DMP model. Krusell et al. (2017) use a search model with an exogenous job-finding rate in which all the action is on the labor supply side. While this is a useful simplification, it does abstract from the hiring decisions made by firms, an important factor in business cycle dynamics.

My second contribution is to the large body of work studying economic recoveries.

This paper advances our understanding of the heterogeneous recoveries different workers undergo and specifically how job switches and job-separations contribute to this heterogeneity. The importance of the job-switching and job-separation rates in the aggregate are well known. Moscarini and Postel-Vinay (2017) tie stronger economic recoveries to higher job-switching rates by noticing that, in the aggregate, the job-switching rate is an important determinant of wage growth. Relatedly, Gertler, Huckfeldt and Trigari (2020) and Fukui (2020) stress the importance of job-switching to understand nominal wage rigidities, a key factor in New-Keynesian models. In addition, researchers have also stressed the importance of movements in the job-losing rate. Elsby, Michaels and Solon (2009) show that, in addition to a falling job-finding rate, increases in the job-losing rate are important to explain the cyclical fluctuations in the unemployment rate. That is, while it is true that following recessions it is harder to find a job, it is also true that it is easier to be laid off. Both these rates contribute to an increasing unemployment pool during recessions. I complement this work by showing that the job-switching and job-losing rates are not only important for understanding aggregate dynamics in the labor market, but also to understand the differences in labor market outcomes across the wealth distribution.

In doing so, this paper complements the recent literature that studies the heterogeneous effects of recessions. Guvenen et al. (2017) document how workers are differently exposed to aggregate shocks. In line with this, Heathcote, Perri and Violante (2020) use a model to show that recessions exacerbate income inequality by causing a fall in hours worked and an increase in non-participation for low-income workers. Similarly, Kramer (2022) shows that poor workers' earnings prospects are worse during recessions in part because these workers have a harder time finding employment. My paper adds to this literature by studying wealth as the source of heterogeneity and by quantifying the effect and analyzing the mechanisms through which the job-switching and job-losing rates contribute to heterogeneous recoveries.

The third strand of literature my work contributes to is wage determination in search and matching models. This paper is the first to consider an alternating offer bargaining protocol in an environment with on-the-job search, curved utility, and asset accumulation. Search and matching models tend to assume linear utility and hand-to-mouth workers. While convenient, these assumptions are unrealistic and restrictive when tackling many questions in macroeconomics. Krusell, Mukoyama and Şahin (2010) construct one of the first DMP models with risk-averse consumers who accumulate assets but do not allow workers to switch jobs. Their work uses Nash bargaining to derive a mapping between assets and wages although, as the authors point out, it is computationally expensive. Including transitions from one job to another gives rise to two ulterior challenges: the presence of three parties in the bargaining, and the potential for re-negotiations. When it comes to wage determination with on-the-job search, the work by Cahuc, Postel-Vinay and Robin (2006) has become the gold standard in the literature. Their elegant solution to this problem is achieved using an infinitely-lived bargaining game à la Rubinstein (1982). However, their formulation of the problem relies crucially on linear utility and hand-to-mouth agents. My wage solution relaxes these assumptions and is able to nest the result in the work by Cahuc, Postel-Vinay and Robin (2006). One further advancement in this literature has been made recently by Fukui (2020). However, this work does not allow for wealth accumulation and is resolved by wage posting à la Burdett and Mortensen (1998), meaning that firms are not allowed to re-negotiate wages when their workers have an outside option.[2]

The bargaining protocol I develop is a finite-horizon variant of the alternating offer bargaining developed by Hall and Milgrom (2008). It resembles that in Christiano, Eichenbaum and Trabandt (2016) but allowing for job-switches. I make three assumptions that lead the bargaining solution to this problem to be computationally efficient and amenable to a large class of models.

Finally, this paper contributes to a substantial literature tying labor market decisions to wealth. Much of this work has concentrated on the labor market decisions of unemployed individuals. Both Chetty (2008) and Krusell, Mukoyama and Şahin (2010) study the effects of more generous unemployment benefits on worker welfare. More recently, Ganong et al. (2022) quantify the effect of extended unemployment benefits on employment during the Pandemic. Similarly, Eeckhout and Sepahsalari (2021) show that wealth affects the job unemployed workers choose to apply for. My work points out that wealth has a larger role to play in labor market decisions and more generally in workers' labor market allocation. Wealth can affect not only the employment decisions of the unemployed but also the job-switching decisions of those already employed, with important consequences for their earnings and aggregate indicators. While there is specific evidence on job-switching and wealth (see Luo and Mongey (2019)), this paper is the first to study the macroeconomic effects of wealth through its role on workers' job-switching behavior.

[2]The fact that workers who have outside offers cannot re-negotiate their wages with the firm they are employed at is not supported by the data. In the NY Fed Survey of Consumer Expectations, I find that roughly half of all workers who receive outside offers try to re-negotiated their wages.

2 Background: Labor Market Outcomes and Wealth

One striking feature of the recovery that followed the Great Recession is how uneven it was. Low-wealth workers suffered worse labor market outcomes than high-wealth workers did. While this behavior is true for a variety of labor market indicators it is best summarized by labor earnings. Figure 1 shows the evolution of labor earnings for low- (red) and high-wealth (blue) workers around the 2001 and the 2007-2009 recessions.[3]

This plot relies on the construction of two variables for each SIPP respondent: labor earnings and wealth. Labor earnings are the wages paid by the worker's employer and as such they exclude other forms of income such as government transfers and business income. Furthermore, I construct these series by excluding those currently unemployed or outside of the labor force as well as the self-employed. While unemployment and non-participation also hit workers differently, by defining labor earnings as I do, I can better capture workers' *quality* of employment[4], the primary concern of this paper. I exclude the self-employed because risk factors other than job-loss (e.g. credit risk) are likely to be more relevant for them.

Wealth is measured as net-worth excluding housing. While results are similar for overall net-worth, the housing exclusion is a more natural benchmark for two reasons. First, there is evidence that, especially for income shocks that are not too large, workers do not alter their housing consumption (see Postlewaite, Samuelson and Silverman (2008) for an example). Second, and in light of this supporting evidence, excluding housing spares me the need to add to the already computationally demanding model a second, illiquid, asset. The threshold separating low- and high-wealth workers is median wealth. Workers are dynamically resorted at each period across the time-varying median threshold. I do so because the length of the panel is rather short for the exercises I perform: it does not exceed 48 months and comes short of that for many of the respondents. For each recession and each group, earnings are normalized to their pre-recession peaks.

The picture painted is striking: following the Great Recession, earnings for workers in the bottom half of the wealth distribution fell by almost 7% and took almost four years to recover to 2007 levels, earnings for workers in the top half of the wealth distribution only suffered a minor, short-lasting decrease.[5] Though less extreme, a similar picture can be

[3] A version of this plot where income is residualized by demographics, industry, and education is shown in Appendix C.

[4] I use a restrictive definition of the word quality that ignores non-wage amenities.

[5] These data are computed using the Survey of Income and Program Participation. Using the Survey of Consumer Finances indicates even more disparity. According to the SCF, low-wealth workers' income suffered a 15% decline that, even by 2019, was still 6% below 2007 levels. At the top half of the wealth distribution, the fall in income was of about 6% and by 2016 earnings were almost 8% higher than 2007

painted for the 2001 recession which saw low-wealth workers experience a greater and longer-lasting earnings fall than high-wealth workers.

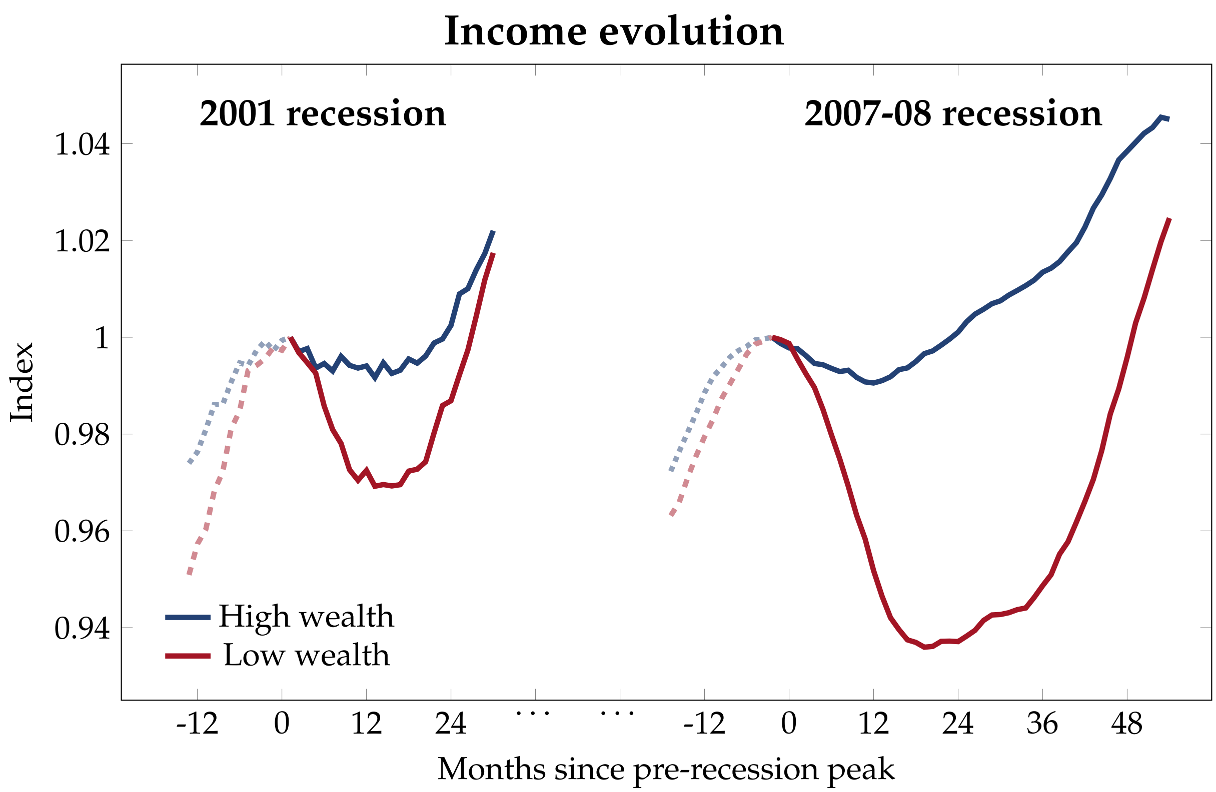

Figure 1: Labor income evolution around recessions, indexed at pre-recession peak. Top half (high-wealth) and bottom half (low-wealth) of net worth distribution excluding housing. Soure SIPP.

Low-wealth workers are generally worst equipped to confront downturns because they cannot rely on their savings to get by in case they are hit by adverse shocks. In addition, at least following the 2001 and 2007-09 recessions, low-wealth workers also suffered a larger and longer-lasting fall in their earnings. What this means is that those workers who are worst equipped to confront a recession also suffer the worst consequences of it. This is why it is so important to understand what drives the heterogeneity in the labor market recoveries of workers with different wealth.

A worker's labor earnings are determined by the job they have and so, to understand where the striking difference across wealth arises from, it is natural to look at the labor flows of workers by wealth. Table 1 displays, in addition to the mean, the standard deviation and persistence of the cyclical component of the job-finding (UE), job-losing (EU), and job-switching (EE) rates computed at a quarterly frequency. In parenthesis are the standard errors for these measures computed by bootstrap.

levels.

The key point of this table is that the behavior displayed by labor earnings is not unique to it: just like labor earnings, the cyclical components of the job-switching (EE) and the job-losing (EU) rates are also more volatile for workers in the bottom half of the wealth distribution. Additionally, the job-switching rate is also more persistent for low-wealth workers.[6] This means that, after a recession, the rate at which low-wealth workers *switch* jobs falls by more and takes longer to recover relative to the rate of high-wealth workers; the rate at which low-wealth workers *lose* their jobs increases by more than for high-wealth workers.

	Mean (%)			Stdv.			Persistence		
	all	low-wealth	high-wealth	all	low-wealth	high-wealth	all	low-wealth	high-wealth
UE	55.79	52.45	61.83	5.46 (0.871)	5.18 (0.765)	5.66 (0.844)	0.9640 (0.037)	0.9598 (0.038)	0.9582 (0.071)
EU	3.65	4.58	2.87	1.48 (0.205)	1.70 (0.234)	1.18 (0.159)	0.8852 (0.073)	0.8798 (0.07)	0.8790 (0.071)
EE	5.99	7.48	4.62	0.89 (0.173)	1.48 (0.392)	0.68 (0.101)	0.8983 (0.075)	0.9013 (0.093)	0.8698 (0.067)

Table 1: Quarterly labor market flow rates across the distribution of net worth excluding housing. "All" is entire sample, "low wealth" and "high wealth" are the bottom and top halves of the net worth ex. housing distribution. Standard deviations and persistence parameters are computed on the Hamilton-filtered rates. Persistence is the AR(1) coefficient. Standard deviations for EE and EU are significantly different according to standard errors computed by bootstrap. All data are computed using SIPP 1996-2013.

This behavior, which standard models of the labor market cannot explain, holds even when residualizing the data by standard controls.[7] At the same time, the cyclical component of the job-finding rate (UE) displays no significant differences across wealth. In the next section I develop a model that can make sense of the heterogeneity in these labor market flows across the wealth distribution and in turn can speak to the earnings gaps across wealth observed in recent recessions.

3 Model

This model incorporates a search and matching structure à la Diamond (1982) and Mortensen and Pissarides (1994), in an incomplete markets, heterogeneous agents model in the vein of Bewley-Huggett-Ayagari[8]. There are four key agents in this model: house-

[6]The difference in persistence across wealth in the EE rate is not statistically significant but, I will show, the model is consistent with this difference.

[7]In Appendix C I show the moments residualized by a polynomial in age, race, sex, education, and the worker's industry of occupation

[8]Bewley (1986), Huggett (1993), and Aiyagari (1994)

holds that can either be employed or unemployed; firms that are either in search of a worker or actively producing goods; capitalists that rent capital to firms; and the government that taxes households to pay for unemployment benefits and government transfers. I go over each of these in detail.

3.1 Households

Households can either be unemployed or employed. If employed, they work for a firm of type $n \in \{1, \ldots N\}$ where n indexes the labor market the firm belongs to. Furthermore, all firms in labor market n have productivity p_n increasing in n.

Unemployed. Unemployed agents choose how much to consume, c, and save, a', using their gross wealth, $(1+r)a$, unemployment benefits, b, and a lump sum government transfer, T. Unemployed agents are always in search of a job. They randomly get a chance to search in one out of N possible labor markets. Specifically, they search in labor market n according to the c.d.f. $G(n|0)$ whose corresponding probability mass function is $g(n|0)$. If searching in labor market n, the agents find a job with probability λ_n[9], otherwise they remain unemployed. The problem they solve is

$$\begin{aligned} U(a,z) &= \max_{c,a'} u(c) + \beta \mathbb{E}\left[\left(1 - \sum_{n=1}^{N} g(n|0)\lambda_n\right) U(a',z') + \sum_{n=1}^{N} g(n|0)\lambda_n E^u(a',z',n)\right] \quad (1) \\ \text{s.t.} &\quad c + a' = (1+r)a + b + T \qquad \text{and} \qquad a' \geq \underline{a} \end{aligned}$$

In addition to wealth, all agents have an idiosyncratic productivity z that evolves according to a first order Markov process, $z' \sim F(z'|z)$. This idiosyncratic term affects how productive agents are when engaged in production with a firm. Because the process $F(\cdot)$ is persistent, z affects the value of unemployed workers not contemporaneously but through the continuation value. When an unemployed agent meets a firm, the value from the match is $E^u(\cdot)$, which can be rewritten as

$$E^u(a',z',n) \equiv E\left(a',z',w^U(a',z',n),n,0\right) \qquad (2)$$

where 0 indicates the worker starts with no tenure at the new job, n indicates the labor market the agent finds employment in, and $w^U(a',z',n)$ is the wage the firm and worker agree on. This wage, which will be discussed in detail in the following section, depends on the state variables (a',z',n) because so do the worker's and firm's outside options.

[9] This will be be an endogenous object.

Employed. Employed agents choose consumption and savings using their gross wealth, $(1+r)a$, after-tax labor income, $(1-\tau)w$, and government transfers, T.They work for a firm on rung n, earn a pre-established wage w, and have tenure j at their current job.

A crucial ingredient of the model that I later validate in the data is that workers' probability of job loss is decreasing in tenure. That is, the longer a worker is at a firm, the less likely she is to be laid off. Thus, the job-loss probability, denoted $\sigma(j)$, is such that $\sigma(j) \geq \sigma(j+1)$. While I provide a microfoundation for this declining hazard rate at the end of this subsection, assume for now that workers of tenure j separate into unemployment with *exogenous* probability $\sigma(j)$. If they do not fall into unemployment, they either continue the relationship with the current firm or get an offer from a new firm on a different rung. Only a random share s of workers on rung n is allowed to search for a new job in any given period. If searching, the probability of searching on rung n' is $g(n'|n)$. Conditional on being able to search on rung n', the probability of an offer from a firm is $\lambda_{n'}$. If the worker does not get an offer, she stays in her current job, earning the same wage but gaining a period in tenure. If the worker does get an offer, she must decide whether to move to the new firm or stay with the old one. In either case the worker negotiates a new wage contract with the firm she ends up with. The problem the worker faces is

$$
\begin{aligned}
E(a,z,w,n,j) \quad &= \quad \max_{c,a'} u(c) + \beta \mathbb{E} \Bigg\{ \sigma(j)\, U(a',z') \\
&\qquad + (1-\sigma(j)) \Bigg[\left(1 - s\sum_{n'=1}^{N} g(n'|n)\lambda_{n'}\right) E(a',z',w,n,j+1) \\
&\qquad + s\sum_{n'=1}^{N} g(n'|n)\lambda_{n'} E^e(a',z',n,n',j) \Bigg] \Bigg\} \qquad (3) \\
\text{s.t.} \qquad & c + a' = Ra + (1-\tau)w + T
\end{aligned}
$$

where the highlighted term $E^e(\cdot)$ represents the worker's value in the case she gets an offer from a firm in rung n'. This term can be rewritten as

$$
\begin{aligned}
E^e(a',z',n,n',j) \equiv \max_{\phi\in\{0,1\}} & (1-\phi)\left\{ E\left(a',z',w_E^{\text{stay}}(a',z',n,n',j),n,j+1\right) + \eta^{\text{stay}} \right\} \qquad (4) \\
& + \phi \left\{ E\left(a',z',w_E^{\text{switch}}(a',z',n,n',j),n',0\right) + \eta^{\text{switch}} \right\}
\end{aligned}
$$

where $\phi = 0$ corresponds to the worker choosing to stay and $\phi = 1$ to switch to firm in labor market n'.[10]

[10] For computational purposes, when making this decision workers are subject to taste shocks η that are independent and identically distributed according to the extreme value distribution with parameter α^{EV},

Consider the tradeoff workers face when switching jobs. There is never a benefit[11] to switching to lower productivity firms. The benefit from switching to a higher productivity firm $n' > n$ is clear: because the firm is more productive, it can offer a higher wage to attract the worker than the original firm can. That is, the negotiated wage with firm n' will be higher than the re-negotiated wage with firm n, $w_E^{\text{switch}}(a', z', n, n', 0) > w_E^{\text{stay}}(a', z', n, n', j)$. At the same time, workers who switch to a new firm give up their tenure: while by staying at the incumbent firm workers gain a period in tenure, going from j to $j+1$, by switching to the poaching firm, workers' tenure falls to 0. The cost of this comes in the form of an increased probability of job loss in later periods. In summary, the trade-off workers face when switching jobs is between a higher wage and a less stable job more likely to lead to unemployment. This trade-off will be key to the results that follow in the paper.

Microfounding $\boldsymbol{\sigma(j)}$. The seminal work by Jovanovic (1979) provides a simple microfoundation for the downward-sloping $\sigma(j)$. This work theorizes that workers and firms slowly learn about the quality of their match. When a worker and firm first sign a contract, they do so with limited information. As time goes by the firm learns how good the match with the worker really is and decides whether to keep or lay off the worker.

Assume that in the first $J-1$ periods of a match the worker is in "training" and is supervised by the firm. The firm observes the worker and forms beliefs about their potential. Worker potential is idiosyncratic to the match and it is high (H) with probability π^H and low (L) with probability $1-\pi^H$. Once the training stops, at J, the worker continues to produce at full capacity if they are high potential but produces no output if they are low potential. In the initial $J-2$ periods the firm only gets a noisy signal of the unobserved worker potential. It uses this signal to determine whether to keep or lay off the worker. At $J-1$, the true potential of the worker is fully revealed and the remaining L workers are laid off.

At $j \geq J$ all workers have a common job-loss probability σ. In the initial periods $j = 1, \ldots J-2$, the firm receives one of two possible signals about worker potential. It either spots the worker committing a mistake and thus revealing they have low potential, in which case the firm fires the worker for sure, or it sees no mistake and the worker is laid off with probability σ. The probability a low potential worker actually commits a

that is $\eta^{\text{stay}}, \eta^{\text{switch}} \sim \mathcal{EV}\left(\alpha^{EV}\right)$.

[11] Other than that provided by the taste shocks which, for sake of the argument I ignore here.

mistake is α^L. This leads to layoff probabilities

$$\sigma(j) \quad = \quad \begin{cases} (1-\pi^H)\cdot\left(1-\alpha^L\right)^j\cdot\alpha^L+\sigma & \text{if } j<J-1 \\ (1-\pi^H)\cdot\left(1-\alpha^L\right)^J+\sigma & \text{if } j=J-1 \\ \sigma & \text{if } j\geq J \end{cases} \tag{5}$$

which, for $j < J$, is downward-sloping in j.[12]

3.2 Firms

Firms can be either vacant or active. Vacant firms are in search of one worker. Active firms engage in production with one worker. Each labor market n is distinguished by its own mass of (identical) vacant and active firms all of which have productivity p_n increasing in n.

Active Firms. Active firms engage in production with one worker. An active firm on rung n has rung-specific productivity p_n and is paired with worker of type (a, z, w, n, j) where w is the wage the two parties negotiated either at the start of the match or the last time the worker had an outside offer. Firms on rung n paired to workers with idiosyncratic productivity z produce according to the constant return to scale technology

$$\begin{aligned} y_n = F\left(k_{-1}, L\right) \quad &= \quad Zk_{-1}^{\alpha}L^{1-\alpha} \\ \text{s.t.} \quad & \quad L = p_n\cdot z \end{aligned}$$

where L are the effective units of labor from the match, Z is aggregate productivity, and k_{-1} is the capital the firm uses in production.

In any given period there is a probability $\sigma(j)$ the match ends. If the match continues, with probability $s\cdot\sum_{n'=1}^{N} g(n'|n)\lambda_{n'}$ the worker receives an outside offer and with the complementary probability the firm and worker continue the existing contract. The value

[12]An alternative formulation, closer to Jovanovic (1979), would have output directly and contemporaneously affected by worker type and in turn would require the firm evaluating whether keeping the worker is preferred to opening a vacancy. While this would lead to a similar result, it would require the addition of at least one state variable in order to keep track of fluctuating output. Because of the already high-dimensionality of the problem I am solving, I do not implement this version quantitatively but rather provide a solution in appendix A.

to the firm is

$$J\left(a,z,w,n,j\right) = \underbrace{y_n - r^K k_{-1} - w}_{\text{flow profits } \pi(k)} + \frac{1}{1+r}\mathbb{E}\Bigg[\left(1-\sigma\left(j\right)\right)\Bigg(\left(1 - s\sum_{n'=1}^{N} g(n'|n)\lambda_{n'}\right)\underbrace{J\left(a',z',w,n,j+1\right)}_{\text{no outside offer}}$$
$$+s\sum_{n'=1}^{N} g(n'|n)\lambda_{n'}\underbrace{J^{ee}\left(a',z',n,n',j\right)}_{\text{outside offer}}\Bigg) + \sigma\left(j\right)\underbrace{V\left(n\right)}_{\text{match ends}}\Bigg] \quad (6)$$

Where J^{ee} is the value of the firm on rung n in case its worker is offered a job on rung n'. This value can be rewritten as

$$J^{ee}\left(\cdot\right) = \begin{cases} V\left(n\right), & \text{if worker switches} \\ J\left(a',z',w_E^{\text{stay}}\left(a',z',n,n',j\right),n,j+1\right), & \text{if worker stays} \end{cases} \quad (7)$$

If the worker switches, firm n opens a vacancy with value $V\left(n\right)$. If the worker decides to stay with n, she renegotiates a wage $w_E^{\text{stay}}\left(a',z',n,n',j\right)$ with the firm.

Vacant Firms. On each rung n there are vacant firms in need of workers in order to start production. These firms pay a fixed cost $\kappa \cdot p_n$ to post a vacancy. Next period they meet a worker with probability q_n, otherwise they remain vacant. The problem they face is

$$V\left(n\right) = -\kappa p_n + \frac{1}{1+r}\left[\left(1-q_n\right)V\left(n\right) + q_n J_0\left(n\right)\right] \quad (8)$$

where $J_0\left(n\right)$ is the value a newly active firm can expect on rung n

$$J_0\left(n\right) = \int_{x^u} g\left(n|0\right) J^0\left(x^u, w^u\left(x^u;n\right)\right) d\Psi^u\left(x^u\right)$$
$$+ \int_{x^e}\sum_{n'>0} g(n|n')\Big[\underbrace{\varphi\left(x^e,n'\right)}_{\text{pr. of poaching}} J^0\left(x^e, w^e_{\text{switch}}\left(x^e,n'\right)\right) + \left(1-\varphi\left(x^e,n'\right)\right)V(n)\Big] d\Psi^e\left(x^e\right)$$

where $x^u \equiv (a,z)$, $x^e \equiv (a,z,n,j)$ and $\Psi^u\left(x^u\right), \Psi^e\left(x^e\right)$ are distributions over x^u, x^e, and J^0 is the same as $J\left(\cdot\right)$ defined in equation (6) but without allowing the worker to switch in the very first period of the match.

$J_0\left(n\right)$ is a weighted average of the value the firm has upon meeting unemployed workers, x^u, and employed workers, x^e. As per the calibration of the model, unemployed workers will always accept jobs with any firm. However, when a vacant firm meets a worker in labor market n' it only poaches them successfully with probability

$\varphi(a, z, n', n, j)$.[13] In this case they negotiate a wage w^e_{switch} and start actively producing, otherwise they do not poach the worker and remain vacant.

Profits. Aggregate profits Π are the sum of flow profits net of vacancy costs from all firms, that is

$$\Pi = \sum_{n=1}^{N} \left[\int_{x^e(n)} \left(y_n - r^K k_{-1} - w(x^e(n)) \right) \, dPsi^e(n) - \kappa v_n p_n \right] \tag{9}$$

where $x^e(n) \equiv (a, z, w, j; n)$ and the last addend are the economy-wide vacancy-filling costs.

3.3 Capitalist and Government

There are two more players in this economy: the capitalist and the government. The capitalist rents out capital to the firms, the government transfers resources from some agents to others making sure its budget is always balanced.

Capitalist. There is a representative capitalist who rents out capital to firms and chooses how much capital to accumulate. Her objective is to maximize the discounted stream of dividends by choosing the total amount of capital to bring into the following periods. This capital investment decision is subject to quadratic adjustment costs. The problem the capitalist faces is

$$(1 + r_t) \mathcal{P}(K_{-1}) = \max_K D_t + \mathcal{P}(K) \tag{10}$$

$$\text{s.t. } D_t = \Pi + r^K K_{-1} - \left[K - (1-\delta) K_{-1} + \frac{1}{2\delta\epsilon_I} \left(\frac{K - K_{-1}}{K_{-1}} \right)^2 K_{-1} \right] \tag{11}$$

where investment $K - (1-\delta) K_{-1}$ is subject to adjustment costs $\frac{1}{2\delta\epsilon_I} \left(\frac{K - K_{-1}}{K_{-1}} \right)^2 K_{-1}$. From this, the usual Q-theory equations follow for Tobin's Q and its law of motion

$$Q \;:=\; \mathcal{P}'(K) = 1 + \frac{1}{\delta\epsilon_I} \left(\frac{K - K_{-1}}{K_{-1}} \right) \tag{12}$$

$$Q_{-1} \;=\; \frac{1}{1+r} \mathbb{E} \left[r^K - \frac{K}{K_{-1}} + (1-\delta) - \frac{1}{2\delta\epsilon_I} \left(\frac{K}{K_{-1}} - 1 \right)^2 + \frac{K}{K_{-1}} Q \right] \tag{13}$$

[13] This poaching probability is derived from the job-switching problem in equation (4).

Government. The government has one role, that of redistributing resources. It taxes all employed agents with an income tax τ to pay for unemployment benefits b and fiscal transfers T. It balances its budget period by period ensuring the following holds

$$\tau \int_{x^e} w(x^E)\, d\Psi^e = b \int_{x^u} d\Psi^U + T \tag{14}$$

where x^E and x^U are defined as above.

3.4 Aggregation

Matching Technology. There is one matching technology $M(\cdot)$ that is the same for all labor markets. If v_n and $searchers_n$ are the mass of vacancies and the mass of agents searching in labor market n, the matching function is

$$M(v_n, searchers_n) \;=\; \chi v_n^{1-\eta} searchers_n^{\eta}$$

While the mass of vacancies on rung n is v_n, the mass of agents searching on rung n is made up of agents from all rungs. In particular, the workers searching on rung n are

$$searchers_n = g(n|0) \int d\Psi^u + s \cdot \sum_{n'=1}^{N} g(n|n') \cdot \int_{x^e(n')} d\Psi^e_{n'}$$

where with $x^e(n')$ I denote employed agents on rung n'. Labor market tightness on rung n is then

$$\theta_n = \frac{v_n}{searchers_n}$$

Because of the CRS matching technology, the vacancy-filling and job-finding rates can then be written as

$$q(\theta_n) \;=\; \chi \left(\frac{1}{\theta_n}\right)^{\eta} \tag{15}$$

$$\lambda(\theta_n) \;=\; \theta_n \cdot q(\theta_n) \tag{16}$$

Equilibrium. The equilibrium in this economy is a set of values for agents and firms $\{U, E, \tilde{E}, V, J, \tilde{J}\}$, policy functions $\{c^U, c^E, a^U, a^E, q\}$, prices $\{r, r^K, w^U(\cdot), w^E(\cdot)\}$, and labor market tightnesses $\{\theta_n\}$ such that

1. Agents, firms, and the capitalist all maximize their respective objectives.

2. The government balances its budget (14).
3. The asset market clears, that is

$$\underbrace{\int_i a^U(i) + a^E(i)\ di}_{\text{HH wealth}} = \underbrace{\mathcal{P}(K)}_{\text{value of capital firm}} \tag{17}$$

where, in steady state, $\mathcal{P}(K) = K$.

4. The labor market trivially clears, that is

$$\underbrace{\sum_{n=1}^{N} \int z \cdot p_n\ di_k^E}_{\text{labor supply}} = \underbrace{\sum_{n=1}^{N} \int L(k)}_{\text{labor demand}}$$

5. Free entry holds on each rung, that is $V(n) = 0$, or using 8

$$q(\theta_n) = (1+r)\frac{\kappa p_n}{J_0(n)} \tag{18}$$

4 Wage Determination

Wages are set using a finite-horizon variant of the alternating offer bargaining protocol developed in Hall and Milgrom (2008). While bargaining with the unemployed agent is a straightforward extension of the environment in Christiano, Eichenbaum and Trabandt (2016), bargaining with job-switchers requires more work. This paper is the first in the search-and-matching literature with on-the-job search to study on-the-job search in an environment with concave utility and asset accumulation. Past DMP models with on-the-job search either assumed linear utility or hand-to-mouth consumption, restrictions that clash with the model I developed.

4.1 Unemployed

When an unemployed agent and a firm of type n meet, a negotiation takes place between the two parties. I succinctly describe the basics of the bargaining pointing out the differences with Christiano, Eichenbaum and Trabandt (2016).

Players and Contract. The players are the worker and the firm of type n that the worker meets. The outcome of the bargaining is a wage paid by the firm to the worker in ex-change for labor services. This wage persists until either the match dissolves or a second firm tries to poach the worker. If at any point an agreement is reached, the worker becomes employed at the firm at the agreed-upon wage and immediately starts production. There are M (odd) sub-periods in which the agent and firm alternate proposing and considering offers. The firm makes offers at odd sub-periods 1, 3, ...M and the worker at even sub-periods 2, 4, ...M-1. If no agreement is reached by M, the agent stays unemployed and the firm remains vacant.

Timing Assumptions. There are two complications here that are not present in Christiano, Eichenbaum and Trabandt (2016): agents have curved utility and there are other relevant state variables that affect the negotiations (assets and idiosyncratic productivity). In order to minimize the computational challenges that are due to these complications I make sure that from one sub-period to the next there are no changes in state variables. In order to achieve this I make the following assumptions:

Assumption 1. Shocks are realized at $m = 1$, interest accrues and the consumption/savings decision is made at $m = M$.

Assumption 2. If a worker signs a contract with a firm at m, output and wages are paid only for the remaining sub-periods $\frac{M-m+1}{m}$.

The first is a timing assumption that restricts the number of computations needed: I need to solve one rather than M consumption/savings problems. The second states that when a worker joins a new firm they only start working at the moment of the signing of the contract and hence only earn (and produce) for the remaining sub-periods. Specifically, a worker is assigned a task at the moment they sign a contract with a firm. If this occurs at sub-period m then the firm assigns a task that can be completed in the remaining $\frac{M-m+1}{M}$ sub-periods. The value of the task in terms of output and wages is also proportional to the number of remaining sub-periods.

Payoffs. If the worker and firm sign a wage contract w_m^n at sub-period m with a firm of type n, the payoffs for each player are

$$W_m^U(a,z,w_m^n) \equiv \max_{c,a'} u(c) + \beta \mathbb{E}\left[\sigma(0)\, U(a',z') + (1-\sigma(0))\, E(a',z',w_m^n,n,0)\right] \tag{19}$$

$$\text{s.t. } c + a' = Ra + (1-\tau)\left[\frac{m-1}{M}b + \frac{M-m+1}{M}w_m^n\right] + T$$

$$J_m^U\left(a,z,w_m^n\right) \equiv \underbrace{\frac{M-m+1}{M}\left(zp_n\left[Zf\left(k\right)-r^K k\right]-w_m^n\right)}_{\text{flow profits}}+\underbrace{\frac{1}{1+r}\mathbb{E}\left[J\left(\psi_a,z',w_m^n,n,0\right)\right]}_{\text{continuation}} \tag{20}$$

These equations make clear that production and wages are pro-rated which incentivizes both parties to find an agreement earlier rather than later in the negotiation.

Procedure and Equilibrium Actions. The players can take one of two actions. If it is their turn to do so, they propose a wage, otherwise they either accept or reject the offer made by the other party. Whenever a wage is rejected the bargaining goes on to the next step: if $m < M$ the bargaining continues in the next sub-period; if $m = M$ the bargaining stops and all parties go back to their previous states, unemployment for the worker and vacancy for the firm. At any point a wage is accepted the negotiation is concluded, the worker must provide its labor to the firm at the established wage and production begins.

At m odd the firm makes the offer and the worker faces an outside option denoted by W_{m+1}^{wait},[14] which is the value the worker can expect if they do not agree to the offer made by the firm. The firm will propose the lowest wage possible subject to the worker not refusing it, that is the firm proposes wage w_m^n satisfying

$$W_m^U\left(a,z,w_m^n\right) = W_{m+1}^{\text{wait}} \tag{21}$$

The worker will accept and the firm will draw value $J_m^U\left(a,z,w_m^n\right)$ from the match – this value will then be the relevant outside option J_m^{wait} for the firm at $m-1$. At m even, it is the worker's turn to propose a wage. The worker makes the firm indifferent between accepting the wage w_m^n and its outside option. This wage solves

$$J_m^U\left(a,z,w_m^n\right) = J_{m+1}^{\text{wait}} \tag{22}$$

The firm will accept and the worker will draw value $W_m^U\left(a,z,w_m^n\right)$ from the match – this value will be the worker's relevant outside option W_m^{wait} for the preceding sub-period $m-1$. The game is solved backwards and will be resolved with the worker accepting the first wage offered by the firm at $m = 1$.

[14]Note that at $m = M$ the outside option the worker faces is $W_{m+1}^{\text{wait}} = U\left(a,z\right)$ because the bargaining ends and the agent goes back to being unemployed.

4.2 Employed

When a worker of type (a, z, w, n, j) gets an offer from firm n' a negotiation takes place between them and the two firms. Unlike the case of the unemployed agent, which is a straightforward extension of Christiano, Eichenbaum and Trabandt (2016), there does not exist a bargaining protocol that can accommodate curved utility and asset accumulation on the part of workers as well as job-to-job switches. In what follows I propose a parsimonious solution to such a bargaining problem.

Players and Contract. The key players are the worker, the incumbent firm n, and the poaching firm n'. The three parties bargain to decide which firm the worker will work for and at what wage. The contracted wage is a per-period wage that is paid by the firm to the worker. The wage is set to last until either the match between worker and firm dissolves or a renegotiation takes place.[15]

Additional Assumption. Assumptions 1 and 2 still hold. Assumption 2 takes on new meaning with job-switchers. As was the case for unemployed agents joining a firm, for job-switchers moving to the poaching firm, production and wages are pro-rated. However, when a worker stays with the incumbent, output and wages are paid for the entire period. Recall that the worker is assigned a task by the firm it works for. Because the worker is under contract with the incumbent from the very beginning ($m = 1$), they will be given a task to be completed over the entire period and, as long as the worker ultimately decides to stay with the incumbent, the full value of it will be realized. If the worker moves to the poacher, the task assigned is smaller, doable in the remaining $\frac{M-m+1}{M}$ sub-periods and its value is proportional to the number of periods the task took to complete. Assumption 3 states what happens to the incumbent task (and consequently to output and wages) when the worker switches from the incumbent to the poacher.

Assumption 3. If the worker signs a contract with the poacher at m, the task at the incumbent remains undone and no output or wages from the incumbent are realized.

While this assumption is not crucial, it greatly reduces the number of cases I have to consider. In appendix B I show that by relaxing this assumption the bargaining outcomes would largely remain unchanged.

Procedure. The bargaining takes place over M (odd) sub-periods where the length of each sub-period is fraction $\frac{1}{M}$ of one whole model period. Firms make offers at odd sub-

[15] Renegotiations occur when the worker gets an outside offer.

periods $1, 3, \ldots M$ and the worker makes offers at even sub-periods $2, 4, \ldots M-1$. The players can take one of three actions depending on whose turn it is to make offers: they can make an offer by proposing a wage (or a tuple of wages in the case of the worker), they can accept an offer, or they can reject an offer. When firms make offers to the worker they simultaneously propose one wage each. The worker can accept at most one of the offers made. If the worker accepts, they sign a binding contract with the firm who made the winning offer. If the worker rejects both offers the game moves on. In particular, if $m < M$ the bargaining continues into the next sub-period $m+1$; if $m = M$ the bargaining stops and all parties go back to their previous states: the worker and firm n remain engaged in production at the original wage w, and firm n' remains vacant.

When the worker makes the offers it simultaneously proposes two wages, one to each firm which, in turn, must respond to these offers simultaneously. If both firms accept, the worker chooses which to sign the contract with. If only one firm accepts, the worker must sign a contract with that firm immediately. If both firms reject the game moves on.

Payoffs. If at sub-period m an agreement is reached and the worker signs a contract with firm n at wage w_m^n the payoffs for each party are

1. Firm n' remains vacant and has payoff $V(n') = 0$
2. Firm n renegotiates the wage with the worker who, having been at the firm the entire period, produces goods for the entire period. The payoff to firm n is

$$J_m^n\left(w_m^n\right) = \left(y_n - r^K k - w_m^n\right) + \frac{1}{1+r}\mathbb{E}\left[\sigma(j)V\left(n\right) + \left(1-\sigma(j)\right)J\left(\psi_a, z', w_m^n, n, j+1\right)\right] \tag{23}$$

3. The worker makes their consumption/savings decision based on the new wage w_m^n and thus their payoff is

$$\begin{aligned} W_m^n\left(w_m^n\right) &= \max_{c,a'} u\left(c\right) + \beta\mathbb{E}\left[\sigma\left(j\right)U\left(a', z'\right) + \left(1-\sigma\left(j\right)\right)E\left(a', z', w_m^n, n, j+1\right)\right] \\ \text{s.t.} \quad & c + a' = Ra + (1-\tau)w_m^n + T \end{aligned} \tag{24}$$

Notice that I do not allow workers to be poached right after the signing of a new contract and this will hold true also in the case the worker joins the poacher.

If at sub-period m an agreement is reached and the worker signs a contract with firm n' at wage $w_m^{n'}$ the payoffs are

4. Firm n' poaches the worker and starts producing from sub-period m onward. Thus,

production and the wage rate paid are pro-rated. The payoff to firm n' is

$$J_m^{n'}\left(w_m^{n'}\right) = \frac{M-m+1}{M}\left(y_{n'} - r^K k - w_m^{n'}\right) + \frac{1}{1+r}\mathbb{E}\left[\sigma(0)V\left(n'\right) + (1-\sigma(0))\,J\left(\psi_a, z', w_m^{n'}, n', 1\right)\right] \tag{25}$$

5. Firm n remains vacant and has payoff $V(n) = 0$[16]
6. The worker makes their consumption/savings decision based on the new wage w_m^n but this is only paid for part of the period. Their payoff is

$$\begin{aligned} W_m^{n'}\left(w_m^{n'}\right) &= \max_{c,a'} u\left(c\right) + \beta\mathbb{E}\left[\sigma\left(0\right)U\left(a', z'\right) + \left(1-\sigma\left(0\right)\right)E\left(a', z', w_m^{n'}, n', 1\right)\right] \\ \text{s.t.} \qquad & c + a' = Ra + \frac{M-m+1}{M}(1-\tau)w_m^{n'} + T \end{aligned} \tag{26}$$

These payoffs point to one important difference between the firms: while anytime the worker stays on with firm n she produces for the entire period, when she moves to n' she only produces for the remaining sub-periods. This asymmetry makes it so that the incumbent firm is "patient" while the poacher is "impatient". Specifically, the poacher wants to sign the worker on as soon as possible in order to prevent it from losing output and hence profits. On the contrary, the incumbent makes the same output regardless of when it signs on the worker.[17]

Definitions and Results. Before considering the actions pursued by the players it is useful to consider a few key concepts. The first is the break-even wage a firm is willing to pay the worker at sub-period m.

Definition 4.1. Denote by $\overline{w}_m^n$ and $\overline{w}_m^{n'}$ the *break-even wages* firms n and n' are able to pay the worker at sub-period m. These wages make the firms indifferent between hiring the worker and opening a vacancy. These wages satisfy

$$J_m^n\left(\overline{w}_m^n\right) = V\left(n\right) = 0 \qquad \text{and} \qquad J_m^{n'}\left(\overline{w}_m^{n'}\right) = V\left(n'\right) = 0$$

where J_m^n and $J_m^{n'}$ are defined in 23 and 25.

This leads to the following result

[16] Once again, this is due to the assumption that the task started by worker for the incumbent n is worthless unless brought to completion. Assuming instead that output and wages were pro-rated for the first m sub-periods would lead to similar final outcomes but through more computational steps.

[17] Technically, the incumbent prefers postponing the signing because while it produces the same output it can lower its wage offer because the poacher's best offer decreases with m.

Result 1. The break-even wage the incumbent n can offer is independent of m, the one the poacher n' can offer is *strictly* decreasing in m, that is:

$$\overline{w}^n := \overline{w}_1^n = \cdots = \overline{w}_M^n \qquad \text{and} \qquad \overline{w}_1^{n'} > \cdots > \overline{w}_M^{n'}$$

Proof. See appendix B □

Once again, this asymmetry between firms stems from the fact that the incumbent firm, n, is "patient": no matter at what sub-period m the firm re-negotiates the contract with the worker, the firm still produces one full period worth of output. This is not true for the poacher n'. Firm n' is "impatient" because by postponing the signing of the contract with the worker, it produces less output and in turn makes lower profits. This asymmetry spills over to the break-even valuations the worker can extract from the firms.

Definition 4.2. Denote by $\overline{W}_m^n$ and $\overline{W}_m^{n'}$ the *break-even valuations* the worker can extract from firms n and n'. They satisfy:

$$\overline{W}_m^n = W_m^n\left(\overline{w}_m^n\right) \qquad \text{and} \qquad \overline{W}_m^{n'} = W_m^{n'}\left(\overline{w}_m^{n'}\right)$$

where $W_m^n(\cdot)$ and $W_m^{n'}(\cdot)$ are defined in 24 and 26.

This leads to the following result

Result 2. The break-even valuation the worker can extract from n are independent of m, the ones it can extract from n' are *strictly* decreasing in m, that is:

$$\overline{W}^n := \overline{W}_1^n = \cdots = \overline{W}_M^n \qquad \text{and} \qquad \overline{W}_1^{n'} > \cdots > \overline{W}_M^{n'}$$

Proof. See appendix B □

This result just states that while the ability of the incumbent firm n to offer value to the worker is not affected by the bargaining sub-period m, the poacher n' becomes more constrained in the value it can provide the worker as m increases. This asymmetry leads to the simple cutoff solution described below.

Sub-game Optimal Strategies. In odd periods m, it is the firms' turn to bid for the worker. The firms bid simultaneously offering the minimal wage that can attract the worker conditional on not paying more than their break-even valuations.[18] Suppose the

[18] This interpretation corresponds to the firms bidding for the worker in a sealed-bid first price auction.

value the worker gets by waiting until the next sub-period, $m+1$, is W^{wait}_{m+1}. If the firms want to attract the worker, they must offer the maximum between the valuation the other firm has for the worker and W^{wait}_{m+1}. A penny less and either the worker accepts the other firm's offer or the worker decides to move to sub-period $m+1$. However, the firms must also not offer the worker more than the break-even valuations as they would otherwise prefer posting a vacancy to hiring a worker. This results in these simple rules for the offers made by firms n and n', respectively:

$$
\begin{aligned}
W^{n,\text{bid}}_m &= \min\left\{\max\left\{W^{\text{wait}}_{m+1}, \overline{W}^{n'}_m\right\}, \overline{W}^{n}\right\} && (27)\\
W^{n',\text{bid}}_m &= \min\left\{\max\left\{W^{\text{wait}}_{m+1}, \overline{W}^{n}\right\}, \overline{W}^{n'}_m\right\} && (28)
\end{aligned}
$$

The inner maximization is required in order for the firm to attract the worker. The outer minimization is required in order for the firm to find it profitable to attract the worker. If both arguments of the minimization are equal, the original firm retains the worker.

In even sub-periods m, it is the worker who makes offers to the firms. The worker proposes the highest wages they can that make each firm indifferent between hiring the worker and moving on to the next sub-period.[19] Consider the offer made to the new firm n'. The worker will make the firm indifferent between accepting wage $w^{n'}_m$ and moving on to $m+1$. If J^{wait}_{m+1} is the value firm n' can expect at $m+1$, this wage will solve[20]

$$
\frac{M-m+1}{M}\left(y_{n'} - r^K k - w^{n'}_m\right) + \frac{1}{1+r}\mathbb{E}\left[J\left(\psi_a, z', w^{n'}_m, n', 0\right)\right] = J^{\text{wait}}_{m+1}
$$

The value to the worker corresponding to this wage is $W^{n'}_m\left(w^{n'}_m\right)$. If firm n can beat this offer then the worker can actually extract a higher wage from firm n'. The worker extracts the following value from firm n'

$$
W^{n',\text{bid}}_m = \min\left\{\max\left\{W^{n'}_m\left(w^{n'}_m\right), \overline{W}^{n}\right\}, \overline{W}^{n'}_m\right\} \tag{29}
$$

where the inner maximization ensures firm n' attracts the worker and the outer minimization ensures firm n' does not pay the worker more than the break-even valuation.

The scenario is simpler when dealing with firm n. While n' can offer the worker more at m than at $m+1$ and in fact compensates the worker for not waiting an extra sub-period, firm n would actually prefer to wait until $m+1$ because it would see no loss in output

[19] This interpretation is equivalent to the worker first making firm n' indifferent between accepting and moving on to the next period and then asking firm n to match that offer.

[20] If n' is not able to poach the worker at $m+1$, J^{wait}_{m+1} is the value of a vacancy, that is 0, and $w^{n'}_m = \overline{w}^{n'}_m$.

but would have to compete with a weaker offer from firm n' (as per result 2).This means the worker will offer firm n a wage delivering them the following value

$$W_m^{n,\text{bid}} \quad = \quad \min\left\{\overline{W}_m^{n'}, \overline{W}^n\right\} \tag{30}$$

Note that the incumbent firm n never gives the worker more than the break-even valuation offered by firm n'. The distinct behavior between the firms is due to the fact that firm n', unlike n, moving from m to $m+1$ loses fraction $\frac{1}{M}$ of output and thus suffers a loss in profits. Because of this, n' compensates the worker for signing the contract earlier rather than later and incentivizes the worker to do so by paying them a premium. For a more thorough explanation of the strategies see appendix B.

Final Outcomes. The bargaining is resolved in the first sub-period. The allocation rule is simple: the worker chooses the firm *able* to provide them with the highest value.

Result 3 (Allocations)**.** The worker is poached by firm n' if and only if $\overline{W}_1^{n'} > \overline{W}^n$. Otherwise she is retained by firm n.

If there were no tenure the worker would go to the most productive firm as that firm is always able to offer the highest wage and hence the highest value (this is the scenario depicted in the first panel of figure 2). But in this model, in which workers value tenure as well as wages, the allocation rule is not that simple. The new firm n' must pay a premium to the worker in order to poach them. This premium compensates the worker for the loss in tenure. This is shown in the second panel of figure 2. What this means is that workers move to firms that are sufficiently more productive than their current firm because only then can the poacher pay a wage high enough to compensate for the lost tenure.

The worker receives values and in turn wages according to the following rule.

Result 4 (Wages)**.** There are four possible scenarios for the wages and values the worker will walk away with:

(1) if $\overline{W}_1^{n'} < W^n(w)$, the worker is retained by n at the original wage w.

(2) if $W^n(w) < \overline{W}_1^{n'} \leq \overline{W}^n$ the worker is retained by the incumbent n at wage $w^{n,B}$ that delivers the worker the break-even valuation of n', it satisfies $W_1^n\left(w^{n,B}\right) = \overline{W}_1^{n'}$.

(3) if $\overline{W}_2^{n'} \leq \overline{W}^n < \overline{W}_1^{n'}$ the worker is poached by n' at wage $w^{n',B}$ that delivers the worker the break-even valuation of n, it satisfies $W_1^{n'}\left(w^{n',B}\right) = \overline{W}_1^n$.

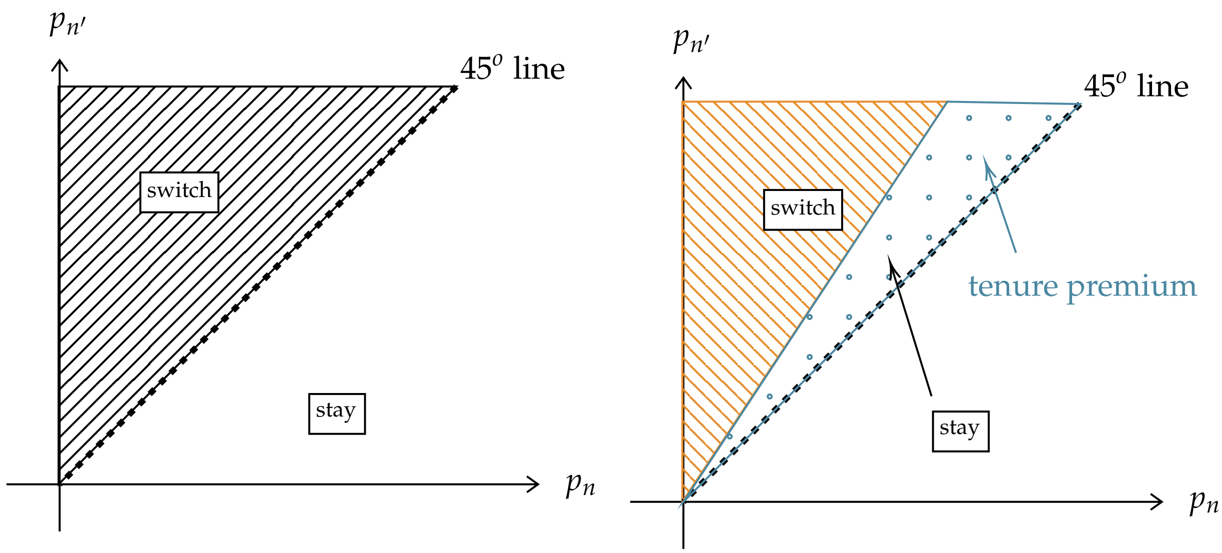

Figure 2: Allocation rules by productivity in an economy with tenure (first panel) and one without (second panel).

(4) if $\overline{W}_2^{n'} > \overline{W}^n$ the worker is poached by firm n' and the wage $w^{n,AOB}$ is agreed upon by one-on-one negotiation between the poacher n' and the worker. This negotiation starts at $m = 1$ and ends at sub-period m^{end}, the last sub-period in which the break-even valuation of n' beats the break-even valuation of n. That is, m^{end} satisfies $\overline{W}_{m^{\text{end}}}^{n'} > \overline{W}^n \geq \overline{W}_{m^{\text{end}}+1}^{n'}$ with $\overline{W}^n$ being the worker's outside option and 0 (i.e. posting a vacancy) the outside option of firm n'. If no such m^{end} exists for $m^{\text{end}} \in \{1, \ldots M\}$ then $m^* = M$.

These outcomes have a simple interpretation which is highlighted in Figure 3.

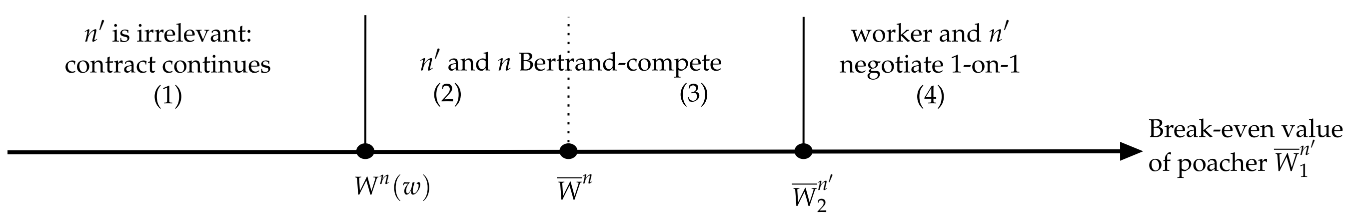

Figure 3: Bargaining outcomes and cutoffs.

In figure 3 there are four regions corresponding to the cases in result (4). In the first three the firms follow the standard Bertrand logic, in the fourth the poacher and the worker enter a simple one-one-one alternating offer bargaining negotiation.

In case (1), the break-even value the poacher is able to offer the worker is lower than the worker's current contract. This leads to no switching and no possible re-negotiation since the worker cannot credibly threaten to leave the incumbent. In case (2) the poacher's break-even value is higher than the worker's current contract but lower than the incumbent's break-even value. This means the worker will stay at the incumbent as long as the incumbent gives the worker a raise. Specifically, the incumbent will offer exactly the break-even value the poacher can offer (as in Bertrand). If it offers less the worker will go to the poacher, if it offers more it is not maximizing its own value. Case (3) works symmetrically to case (2) except the worker is poached and the poacher offers a wage delivering the worker the break-even value the incumbent can afford.

Case (4) is different from the other three. The break-even value of the poacher is so much higher than that of the incumbent that even in sub-period $m = 2$ the poacher would be able to win over the worker. This makes the poacher "compete" against time rather than against the incumbent. While in (3) waiting means the poacher loses the worker, in (4) waiting means losing profits but still poaching the worker. This leads the worker and the poacher to negotiate one-on-one. The outside option relevant for this negotiation will be determined backwards starting from the first sub-period after the break-even valuations of the two firms cross. At that m^{end}, waiting means the poacher will no longer be able to poach the worker. The bilateral negotiation starts at m^{end} and, if it is the worker's turn to make the offer, it proposes $\overline{w}^{n'}_{m^{\text{end}}}$ extracting the break-even wage from n'; if it is the firm's turn to make the offer it proposes a wage delivering the break-even value of the incumbent, $\overline{W}^{n}$, to the worker. The negotiation then continues backwards until $m = 1$ as in the standard alternating offer bargaining with two players.[21]

Taste Shocks. As stated in equation 4, workers are subject to taste shocks when they choose whether to stay or switch jobs. Here I assume that taste shocks have no role when firms n and n' Bertrand-compete for the worker.[22] They play a role solely when the worker negotiates the wage one-on-one with the firm. In this case, the negotiated wages are determined as spelled out above. The value and the allocation probability the worker gets are derived using the standard formulas for extreme-value (type I) errors.

5 Calibration

The model is calibrated to match key moments of the US economy with particular attention to its labor market. I start by estimating the set of parameters that pertains to the risk incurred when workers switch jobs.

[21]The negotiation from now on is very similar to that of the unemployed worker and the firm.

[22]If I allowed for taste shocks here the worker would go to the incumbent and poacher with the same probability $\frac{1}{2}$.

5.1 Job-Switching Risk Estimation

At the heart of the model lies the risk that workers incur when moving from one job to another. I estimate this risk using the SIPP and show that it is statistically and economically significant. When a worker moves to a new job they face a probability of job loss that, over the first fifteen months following the move, is between 6 and 12 percentage points higher than if they had not switched jobs.

I quantify this risk using an event study similar to that of Davis and Von Wachter (2012). The goal of this event study is to capture the *additional* probability that a worker will suffer an unemployment spell after switching jobs. To do this, I follow workers in the SIPP panel, tracking their job switches (by using the identifier of the firms at which they are employed) and their moves from employment into unemployment. The linear probability model I run is

$$\mathbb{1}\left(\mathrm{EU}_{i,t}\right) = \sum_{k=-1}^{14} \boldsymbol{\theta_k} \boldsymbol{D^k_{i,t}} + \underbrace{\alpha_i}_{i\text{-FE}} + \underbrace{\beta_t}_{t\text{-FE}} + \Gamma X_{i,t} + \varepsilon_{i,t} \tag{31}$$

where $\mathbb{1}\left(\mathrm{EU}_{i,t}\right)$ are realizations of worker i's moves from employment in period t to unemployment in period $t+1$, $\boldsymbol{D^k_{i,t}}$ are a series of dummy variables that take on value 1 if worker i at time t switched jobs k months back, α_i and β_t are individual and time fixed effects, respectively, and $X_{i,t}$ are time-varying controls for individual i such as age and industry of occupation. What θ_k captures is the additional probability a worker who switched jobs k periods back faces of falling into unemployment compared to a similar worker who did not switch. Figure 4 illustrates these θ's over the fifteen months after a job switch estimated over both the full sample (black line) and over recession periods only.

Three aspects emerge from the results depicted in Figure 4. First, the estimates are positive meaning that workers who switch jobs face a higher risk of falling into unemployment compared to similar workers who do not switch jobs. Second, this additional probability of job loss is persistently positive, going to 0 only after fifteen months from the start of the new job. Third, the effect of job-switching on the probability of job loss is greater during recessions (red line).

A potential weakness of this specification is due to selection effects. The reason behind workers' decision to switch, rather than switching itself, might cause the increase in job loss probability. While the fixed effects help with many of the potential selection problems, one potential concern remains: the θ's might reflect workers deciding to switch *because* their old job is at risk. For example, it is reasonable to think that an unproductive

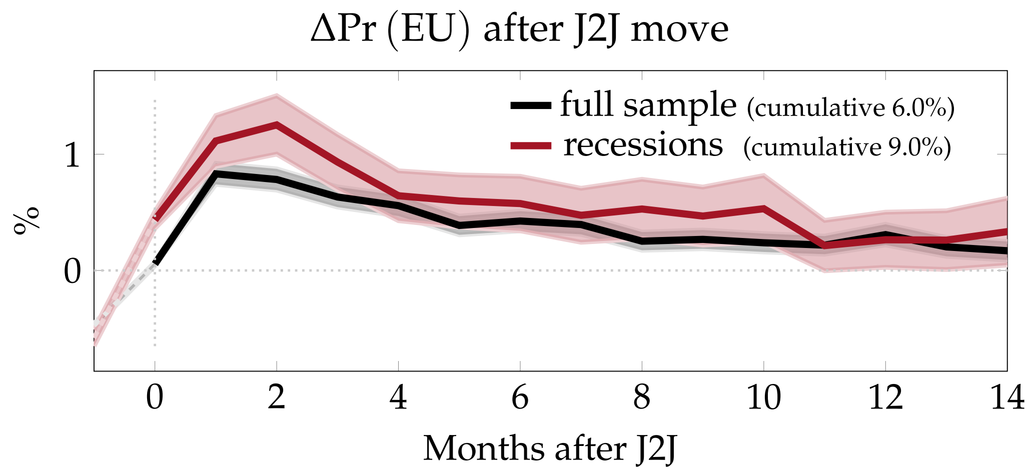

Figure 4: Change in probability of (involuntary) separation into unemployment after a J2J transitions. Estimated using SIPP, following 31.

worker will switch jobs in order to avoid being laid off.[23] At the new job, however, the firm will sooner or later realize the worker is unproductive and will ultimately terminate the worker. If this behavior were common in the data, it would result in something similar to Figure 4, but without implying that switching is inherently risky. While I cannot control for this channel explicitly, I can attenuate its concern. To do so, I run the same regression in equation 31 but only considering job-switchers to be those workers who switch from lower- to higher-paying jobs. More than two-thirds of job-to-job moves fall in this category. How does this address the selection issue brought up above? While it does not completely resolve the issue, it mitigates it considerably. Workers who are about to be laid off are more desperate to find new employment quickly in order to avoid unemployment. As a consequence, these workers should be relatively more willing to move into lower-paying jobs. Restricting the definition of job-to-job switches to those workers moving into higher-paying jobs removes many of the workers who switch *because* they are at risk of layoff, in turn mitigating a major selection concern for my analysis. As Figure 5 shows, this specification is qualitatively and quantitatively similar to the original specification shown in Figure 4, suggesting that the particular selection problem discussed is not a serious challenge to the validity of the event study.

Beyond being statistically significant, these results are economically significant. Over the first fifteen months following a job-to-job transition, the probability of a worker falling into unemployment increases by between 6 and 12 percentage points. The estimates are

[23] One could argue that the worker controls are already accounting for "unproductive workers", however, it is possible that some selection for unproductive switchers persists even after accounting for the relevant controls.

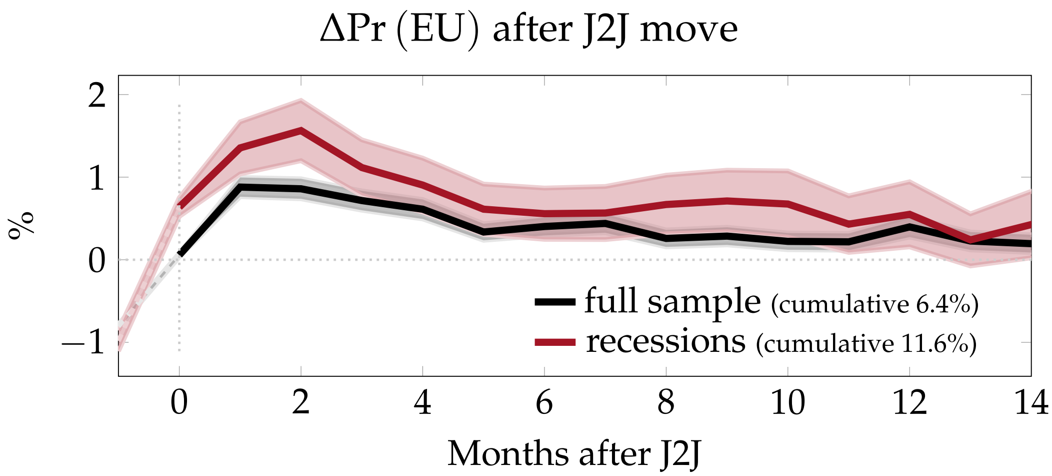

Figure 5: Change in probability of separation into unemployment after a J2J transitions. Estimated using SIPP, following 31 when restricting job switchers to those that see a strict wage increase in moving from the old to the new job.

highest during recessions, as both Figures 4 and 5 show, and for low-wealth workers, as shown in Appendix C. Considering that, over the same fifteen month period, the probability that the average US worker falls in unemployment is roughly 18%, these estimates indicate a considerable increase in risk: workers who switch jobs face a one to two thirds higher likelihood of being hit by an unemployment spell in the fifteen months after the job switch. Because, as I will discuss below, I calibrate my model so workers never switch to lower-paying jobs, my preferred estimate $\sigma(j)$ is given by the black line in figure 5 aggregated to a quarterly frequency.

In the next section, I study the economic consequences of this increased risk of job-loss through the lens of my model but before doing so I discuss the calibration of the remaining model parameters.

5.2 Aggregate Moments

The other model parameters are calibrated to match key moments of the US economy and in particular the US labor market. Table 2 displays the parameters used in the model.

Utility takes the form of a standard CRRA with risk-aversion parameter $\gamma = 2$. In order to match the empirical wealth distribution in the US, I use permanent discount factor heterogeneity as in Krusell and Smith (1998), with two levels $\beta^L = 0.9565$ and $\beta^H = 0.9835$, calibrated to match the quintiles of the wealth Lorenz curve for the US.

The production parameters are standard in the literature. I use a capital share $\alpha = 0.3$ and a quarterly depreciation rate of capital $\delta = 2.5\%$. The elasticity of investment to q is

	Parameter (Quarterly Frequency)	Value
Household		
$u(c)$	Utility func.	$\frac{c^{1-\gamma}}{1-\gamma},\ \gamma = 2$
(β^L, β^H)	Discount factor	$(0.9565, 0.9835)$
Firm		
α	Capital share	0.3
δ	Capital depreciation	2.5%
ϵ_I	Elasticity of I to q	4
Fiscal		
b	Unemp. benefits	0.2
T	Lump sum transfer	0
Labor Market		
s	On-the-job search intensity	0.35
$g(k+1 \mid k)$	Prob. search on next rung	1
ζ	Vacancy cost	0.8
η	Matching elasticity	0.5
χ	Matching efficiency	0.5
M	Bargaining periods	3
α^{EV}	Std. of taste shocks	$1/100$
π^G	Prob. high potential	0.9424
α^L	Prob. informative (L) signal	0.39

Table 2: Model Parameters.

set to 4 as in Auclert et al. (2021).

I assume that in steady state the government pays no lump sum transfers to agents ($T = 0$) but pays unemployment benefits $b = 0.2$ where this is set to match the empirical ratio of unemployment expenditures to GDP of roughly 0.3%.

The labor market parameters help match quarterly moments of the labor market, specifically the job-finding probability, 56%, the unemployment rate, 5.5%, and the job-switching probability, 6%. The model parameters that are most useful for hitting these targets are the intensity of search when employed, $s = 0.35$, the vacancy posting cost per unit of firm productivity, $\zeta = 0.8$, the matching elasticity, $\eta = 0.5$, and the matching efficiency, $\chi = 0.5$. Furthermore, I impose that agents and firms have three sub-periods, $M = 3$, to bargain over a wage, that is, each month firms and agents alternate in making and considering offers. π^G and α^L, the probability a worker has potential and the probability the firm gets an informative signal, are chosen to match the empirical additional probability of job-loss estimated in the previous sub-section.

5.3 Job-Switching Elasticity

I first test the validity of the calibrated model by checking whether it can replicate a crucial untargated moment from the data. The moment of interest is the elasticity of job-switching to wealth. The precautionary job-keeping motive emerges as a positive relationship between wealth and the probability of switching jobs and should thus be reflected in a positive elasticity. To compute this elasticity of job-switching to wealth in the SIPP, I run the following regression

$$\mathbb{1}\left(\mathrm{EE}_{i,t}\right) \quad = \quad \beta_0 + \boldsymbol{\beta_1}\frac{\mathrm{Wealth}_{i,t}}{\mathrm{Income}_{i,t}} + \vec{\gamma}X_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \tag{32}$$

On the left-hand side are realizations of job-switches for worker i at time t (1 if the worker switches, 0 otherwise). On the right-hand side are worker i's wealth-to-income ratio at time t, time and individual fixed effects, as well as standard controls.[24]

I run the exact same regression using the model steady state. I simulate individual employment and wealth paths for agents in the model and use them to run regression 32.[25] The results of these regressions, both in the SIPP data and using the model-simulated data, for low-wealth and high-wealth separately, are shown in table 3. The model does a good job matching the untargeted empirical elasticities. Just as in the data, a wealth increase equal to one year worth of income is associated with an increased probability

[24]I control for polynomials in age and tenure, industry, education, race, marital status, family size.

[25]I only control for tenure and individual fixed effects when running the regression in the model.

of job-switching for low-wealth workers of roughly 0.9 percentage points. On the other hand, the same increase barely changes the job-switching behavior of high-wealth workers. This asymmetry is consistent with the precautionary job-keeping motive, according to which the job-switching behavior of low-wealth workers is sensitive to changes in wealth while that of high-wealth workers is not.

β_1: job-switching elasticity

	low-wealth	high-wealth
Data	9.0e−3	5.7e−5
	(2.2e−3)	(1.0e−5)
Model	8.9e−3	1.6e−3
	(3.6e−8)	(8.0e−10)

Table 3: Job-switching elasticity to wealth-to-income ratio in the data (SIPP) and the calibrated model. The regression is run only on workers employed at t. Standard errors in parenthesis.

To interpret these numbers it is useful to note that the average wealth-to-income ratio fell from 6.7 to 5.47 during the Great Recession and increased from 6.49 to 8.25 after the Pandemic.

6 Mechanisms and Matching the Business Cycle Moments

In this section I detail how having a job-loss probability that is declining in tenure gives rise to two novel mechanisms: the precautionary job-keeping motive and the tenure-wealth correlation. I then show how these mechanisms in turn help the model match the empirical cyclical moments of the job-switching and job-losing rates across the wealth distribution.

6.1 Precautionary Job-Keeping

The precautionary job-keeping motive is the causal mechanism that enables the model to match the volatility and persistence of the cyclical component of the job-switching rate across the wealth distribution. At the heart of this mechanism is the trade-off between wages and job-stability that all workers face when switching jobs. However, high- and low-wealth workers respond differently to this trade-off, with low-wealth workers valuing job-stability relatively more. This results in low-wealth workers being, all else equal, less willing to switch jobs. In a recession in which wealth falls, this mechanism is amplified and further depresses the job-switching rate for low-wealth workers.

Equation 4 displays the trade-off workers face when switching jobs: they may get higher wages when they start working for a higher productivity firm but this comes at the cost of lost tenure and consequently lost job security.[26] With low tenure comes higher unemployment risk which low-wealth workers are more sensitive to as they have fewer savings and hence limited insurance in case they are indeed subject to an unemployment spell. To see why this is, consider a worker who falls into unemployment. The worker can use unemployment benefits and her previously accumulated savings towards consumption. A high-wealth worker will fare better than a low-wealth worker throughout the unemployment spell simply because her wealth allows her to afford higher (and smoother) consumption. Thus, low-wealth workers are more sensitive to the increase in unemployment risk they face when switching jobs and have a stronger precautionary incentive to stay at their jobs.

Figure 6 is useful to understand different workers' propensity to the precautionary job-keeping motive in my model. It plots the value functions of a particular worker faced with the choice of switching to a new firm (green dashed) and staying at the old firm (orange solid) as the worker's wealth varies. For high levels of wealth, switching to the new firm dominates: for this worker the income increase upon switching outweighs the loss in job security. On the contrary, for low levels of wealth, staying at the old firm dominates: this worker prefers the relatively higher job security granted by the old firm to the higher wage received at the new firm. In particular, for every worker type (ϵ, w, n, j) there exists an asset threshold $\overline{a} \in [\underline{a}, \infty]$ such that the worker moves to the new firm only if her wealth exceeds this threshold ($a \geq \overline{a}$).

In principal, aggregating the individual policy functions across all workers in the economy delivers a probability of switching jobs that is increasing in assets. However, there is a small caveat to this assertion in the quantitative model. As highlighted earlier, workers are subject to taste shocks when choosing whether to stay or switch jobs. As wealth increases these taste shocks become relatively more important and, as assets grow very large the probability of switching is completely determined by the taste shock.[27] However, for all practical purposes, all but the very wealthiest agents in the model face an upward-sloping probability of switching jobs as shown in figure 7.

Figure 7 further displays the steady state distribution of workers across assets (green dashed line). As emphasized by the vertical green dotted line which separates the bottom

[26] Wages at the new firm $n' > n$ are greater than wages at the old firm n but tenure at the new firm starts over from 0 while by staying at the old firm it increases to $j + 1$.

[27] The probability of switching goes to $\frac{1}{2}$ as assets $a \to \infty$.

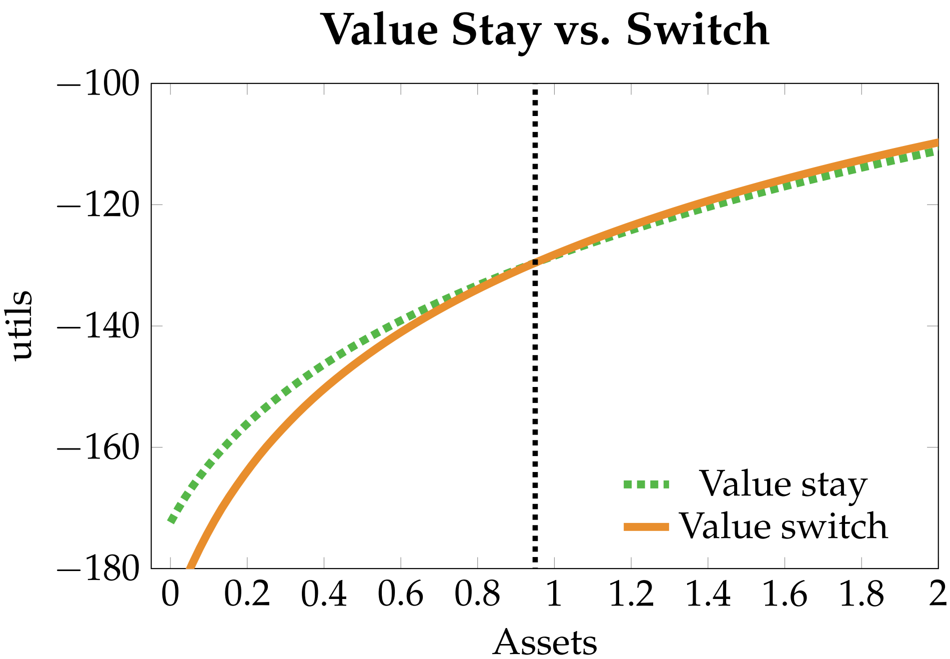

Figure 6: Model value functions for stayers and switchers.

half from the top half of the wealth distribution, workers at the bottom of the wealth distribution face a much steeper probability of switching jobs than workers at the top of the wealth distribution. This is entirely a reflection of diminishing marginal utility: while on the one hand even a considerable change in wealth does little to affect the probability of switching jobs for wealthy workers, on the other hand, the probability of switching jobs is very sensitive to changes in wealth for low-wealth workers.

When a recession hits the economy and depletes wealth, workers slide along the wealth distribution. The distribution of workers following a recession is depicted in figure 7 (red dashed line). An important effects of this shift is that for the large mass of workers who had relatively low wealth to begin with, the probability of switching jobs falls by a considerable amount. In other words, after a recession there is more mass at the part of the distribution with low job-switching probability because, as workers lose their wealth, their precautionary job-keeping motive becomes stronger. For workers with relatively high wealth, however, even a sizable loss in wealth does not translate into a noticeable change in job-switching probability. These forces explain the higher volatility of the job-switching rate at the bottom of the wealth distribution relative to that at the top. Finally, because wealth builds up slowly, these forces take a long time to die out, explaining the higher persistence of the job-switching rate for low-wealth workers.

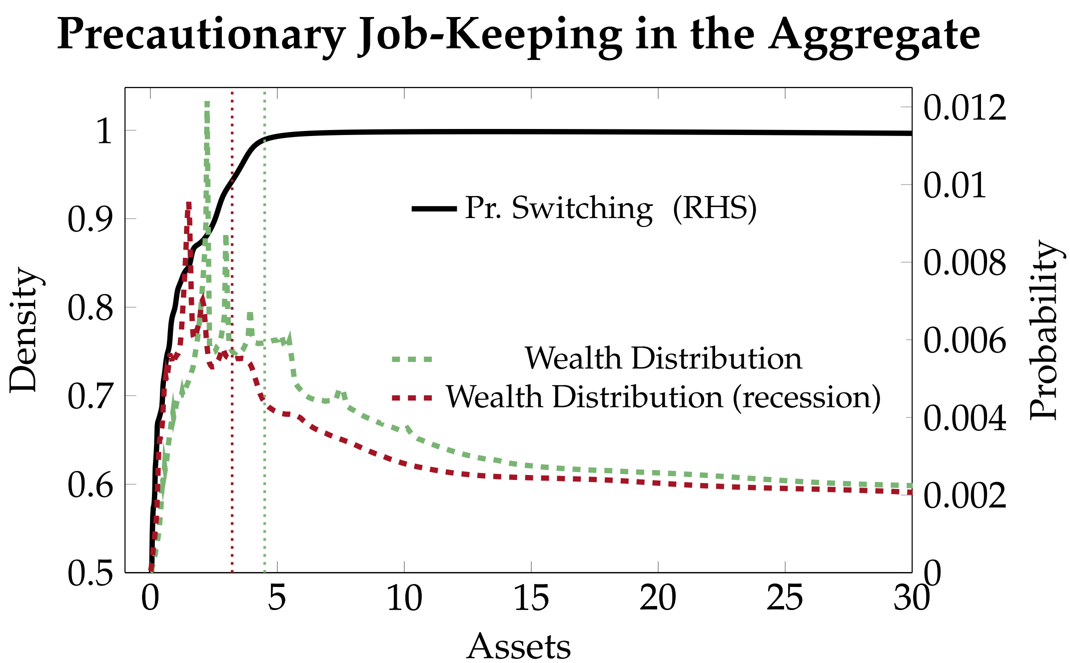

Figure 7: Model derived job-switching, steady state distribution (green), and recession distribution (red). Dotted lines indicate median wealth thresholds.

6.2 Tenure-Wealth Correlation

The tenure-wealth correlation is the mechanism that allows the model to match the volatility and persistence of the cyclical component of the job-losing rate across the wealth distribution. Unlike precautionary job-keeping, which *causally* links workers' wealth to their job-switching behavior, the tenure-wealth correlation links workers' wealth to their risk of job loss through the model's dynamic selection forces.

The tenure-wealth correlation manifests itself as a correlation between workers' wealth and their tenure which, in turn, implies a correlation between wealth and the probability of job-loss. As I explain in detail below, at the heart of this mechanism are two facts: recessions tend to reshuffle workers towards lower tenure jobs, and this reshuffling overwhelmingly affects low-wealth workers. This leads low-wealth workers to be more likely to lose their jobs since low-tenure implies a higher job-loss probability. Low-wealth workers then, as the economy recovers, cycle between low-tenure jobs and unemployment until they are able to break this vicious cycle by gaining enough tenure at their job.

After recessions hit an economy, the unemployment pool grows. This is in part due to a decrease in the job-finding rate and in part to an increase in the job-losing rate. As the economy recovers the large pool of unemployed workers slowly re-enters the labor market but these workers, because they are newly employed, occupy low-tenure jobs.

This translates into a shift in the distribution of workers towards lower tenure jobs with higher probability of job loss. In panel A of figure 8 I show that this reshuffling is present in the data, with higher tenure jobs losing employment share to lower tenure jobs.[28]

Low-wealth workers are overwhelmingly subject to this redistribution because they make up a larger share of the unemployment pool, especially during recessions. There are two reasons for this. The first is that during a recession the duration of unemployment increases and hence the unemployed run down their savings more than in normal times. The second is that, in any given period, low-wealth workers make up a larger share of job-losers because they tend to occupy a larger share of low-tenure jobs.

The fact that low-wealth workers make up a greater share of low-tenure jobs, may seem puzzling. After all, it is low-wealth workers who, because they are more susceptible to the precautionary job-keeping motive, value tenure the most. However, this logic is trumped by the model's dynamic selection forces as panel B of figure 8 shows and is also reflected in the data (as panel C shows). While it is true that low-wealth workers are more susceptible to precautionary job-keeping, these workers tend to have low wealth precisely because they have had an unfortunate labor market history. Workers' wealth is the cumulation of their earnings (net of consumption) which are determined by their labor market histories. As a consequence, wealth will depend on three factors: how many periods a worker has spent in employment versus unemployment, the quality of jobs the worker has had, and the idiosyncratic productivities the worker has been subject to. As such, low-wealth workers must have either suffered frequent or long unemployment spells, have not switched to better jobs, or have experienced long streaks of low idiosyncratic productivity. The first of these leads to the correlation between wealth and tenure.

Low-wealth workers tend to have experienced more frequent unemployment spells. This mechanically makes *employed* low-wealth workers more likely to be in a new job with low tenure. These dynamics are shown in figure 9 in which both panels are based on model simulations in steady state. Panel A shows how many unemployment spells a worker has suffered over the previous four years. On average only 40 percent of low-wealth workers have suffered no unemployment spells in the past four years compared to 80 percent for high-wealth workers. Panel B shows tenure histories over the past

[28] This fact in of itself, abstracting from distributional aspects, has a significant implication for the cyclicality of the job-separation rate. Roughly five percent fo the workforce experiences a fall in tenure. According to the estimates of the separation probability by tenure, this redistribution of workers along tenure implies roughly a 0.15 percentage point increase in the monthly separation probability. Given the average monthly separation probability is roughly 1%, this is not an insignificant increase. This 0.15 percentage point increase represents roughly one fourth of the total increase in the separation probability experienced during the Great Recession, which went from 1.2% to 1.8%.

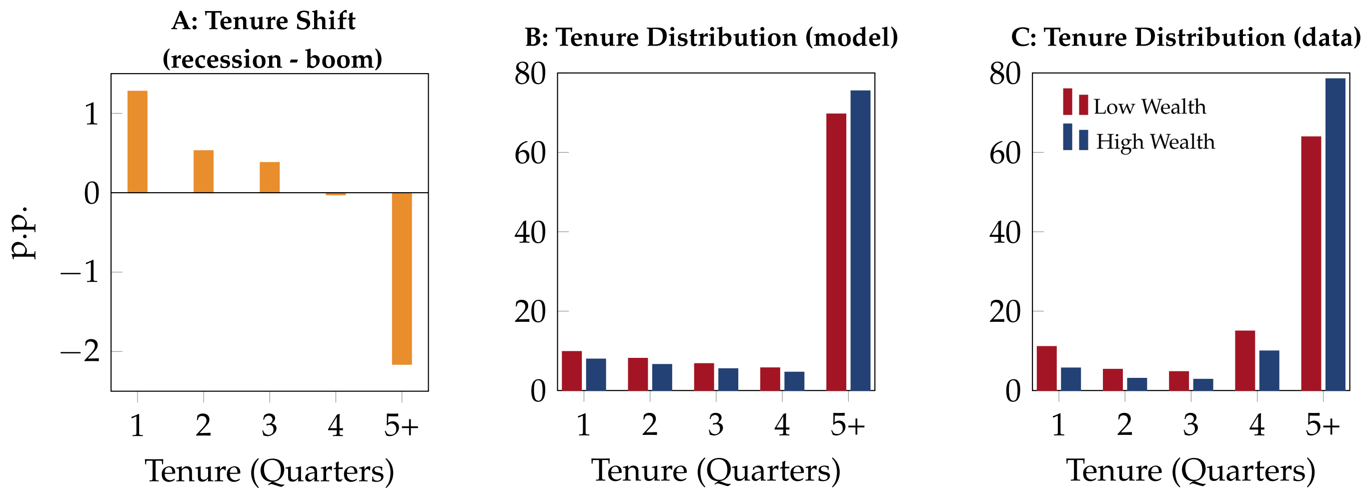

Figure 8: Worker tenure distribution in model and data. Panel A shows the change in the empirical tenure distribution over recessions and booms. There is more concentration in low-tenure jobs than high-tenure jobs. Panels B and C show the steady state (model) and the full-sample (data) distribution of workers over tenure by wealth. Both these plots make clear that low-wealth workers have more weight in lower tenure positions.

four years: low-wealth workers have disproportionately occupied lower tenure jobs than high-wealth workers. The two panels are linked: low-wealth workers tend to occupy low tenures because they tend to have entered the labor market more recently.

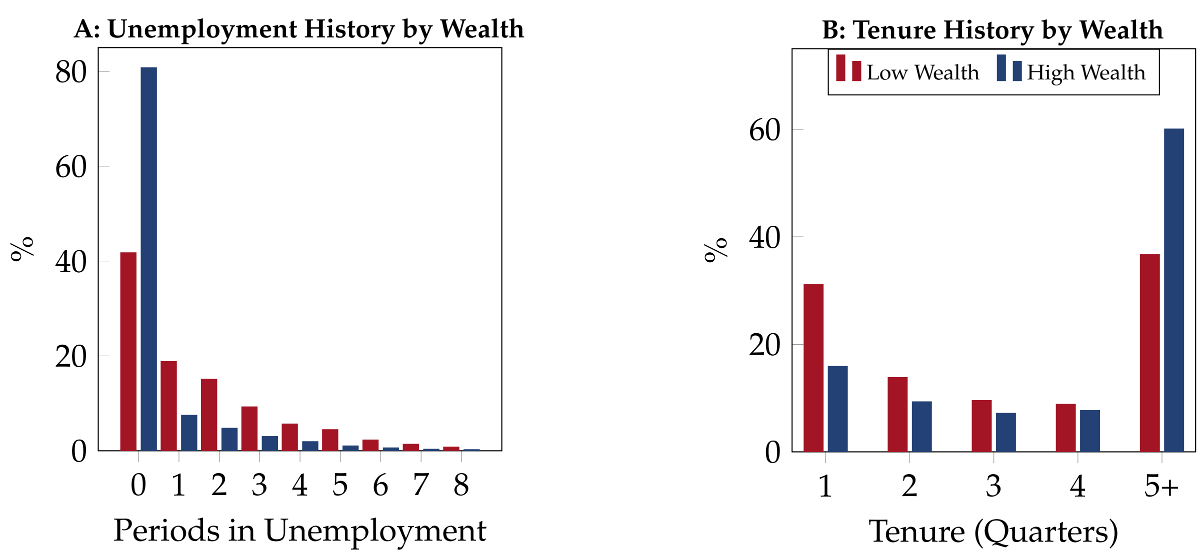

Figure 9: Worker unemployment and tenure history in steady state. Each plot shows the frequency of unemployment spells (panel A) and of tenure states (panel B)

In sum, because low-wealth workers are reshuffled towards low-tenure jobs that are likelier to lead to layoffs, these workers see a larger increase in their probability of falling into unemployment following recessions. Furthermore, because workers with low-tenure are not just more likely to experience an immediate unemployment spell but also one in the near future,[29] this increase in separation probability is not only larger but also longer-lasting.

6.3 Empirical Moments

The first success of the model is in its ability to match the cyclical moments of the job-switching (EE) and job-losing (EU) rates across the wealth distribution.

To do so, I postulate a joint stochastic process for productivity, Z, and common job-loss probability, σ, that is a level shift in every workers' job-loss probability. These processes are

$$\sigma_t - \sigma^* = \rho^\sigma \left[\sigma_{t-1} - \sigma^*\right] + \epsilon_t^\sigma \tag{33}$$

$$\log\left(Z_t\right) - \log\left(Z^*\right) = \rho^Z \left[\log\left(Z_{t-1}\right) - \log\left(Z^*\right)\right] + \epsilon_t^Z \tag{34}$$

where

$$\begin{pmatrix} \epsilon_t^\sigma \\ \epsilon_t^Z \end{pmatrix} \sim \mathcal{N}\left(\vec{0}, \Sigma = \begin{pmatrix} Var(\sigma) & Cov(\sigma, Z) \\ Cov(\sigma, Z) & Var(Z) \end{pmatrix}\right) \tag{35}$$

Using the sequence-space Jacobian approach developed in Auclert et al. (2021), I compute transitional dynamics for the model and estimate these processes to match the headline standard deviations and persistence of the job-switching, job-losing, and unemployment rates.[30] With these estimates I compute the moments for the bottom and top of the wealth distribution using simulation. In table 4 I show the standard deviations in the data, in the model, and in a "naïve" model. The naïve model is exactly the same model I described above with the same calibration except there is no decreasing job-loss probability in tenure. Instead of $\sigma(j)$ decreasing in j, the naïve model has a constant σ that is calibrated to match the unemployment rate in the benchmark model. Table 4 shows that the benchmark model does a good job matching the dispersion across wealth in the EU and EE rates. Just as in the data, the volatility of the EE and EU rates is almost double for low-wealth workers than it is for high-wealth workers. On the contrary, the naïve model

[29] Workers who suffer an unemployment spell now will fill low-tenure, high-separation probability jobs once they re-enter the labor market.

[30] I also try a version matching the job-finding rather then the unemployment rate. This still delivers reasonable results for the dispersion across wealth in the estimates for job-switching and job-losing, the main goal of this exercise, but it delivers quite poor results for the job-finding rate. This is because my model, as is, does not resolve the Shimer puzzle Shimer (2005). More details on the estimation are in appendix . . . .

is unable to match these moments. The naïve model is doomed to fail when it comes to the job-losing rate (EU) since, by construction, the model has a constant job-loss probability for all workers. However, even in the case of the job-switching rate (EE), the naïve model displays little difference between volatility for low- and high-wealth workers and nothing compared to the dispersion seen in the data.[31]

Standard Deviation (by wealth)									
	Data			Model			Naïve Model		
	all	low	high	all	low	high	all	low	high
EU	1.48	1.70	1.18	0.86	1.29	0.57	1.12	1.12	1.12
EE	0.89	1.48	0.68	0.87	1.41	0.55	0.85	0.88	0.82
u	1.57	2.45	1.03	1.13	1.21	1.09	1.35	1.36	1.35

Table 4: Standard deviations of job-switching and job-losing rates across the distribution of net worth excluding housing. The table reports the moments for the standard deviations computed on the Hamilton-filtered rates. All data are computed using SIPP 1996-2013.

In the next section I show why capturing these moments is important to understand aggregate economic dynamics in the labor market.

7 Results

Precautionary job-keeping and the low-tenure trap contribute to the slower earnings recoveries experienced by low-wealth workers relative to high-wealth workers. Taken together, these two mechanisms explain 42% of the earnings gap dynamics observed after the Great Recession. In addition, through precautionary job-keeping, the model provides a possible explanation to the Great Resignation, the sudden increase in job-switching the US labor market experienced following the Pandemic, via the large government stimulus issued over this period.

7.1 Great Recession Earnings Recovery

The 2007-2009 recession was the largest to hit the United States since the Great Depression. However, this recession did not affect all workers equally: labor earnings for low-wealth workers fell by more and recovered more slowly than for high-wealth workers.

[31] The little difference that come out of the model is due to bunching at the top of the job ladder that is more prevalent among high-wealth workers.

Here I assess how well the model I developed can speak to the heterogeneous earnings dynamics across the wealth distribution.

I start by estimating paths of shocks for productivity, Z_t, and for the common job-loss probability experienced by all workers, σ_t, to exactly match the output and unemployment dynamics observed during the Great Recession. The targeted paths for unemployment and output are shown in Figure 10. Subjecting the model to these shocks I compute labor earnings for low- and high-wealth workers.

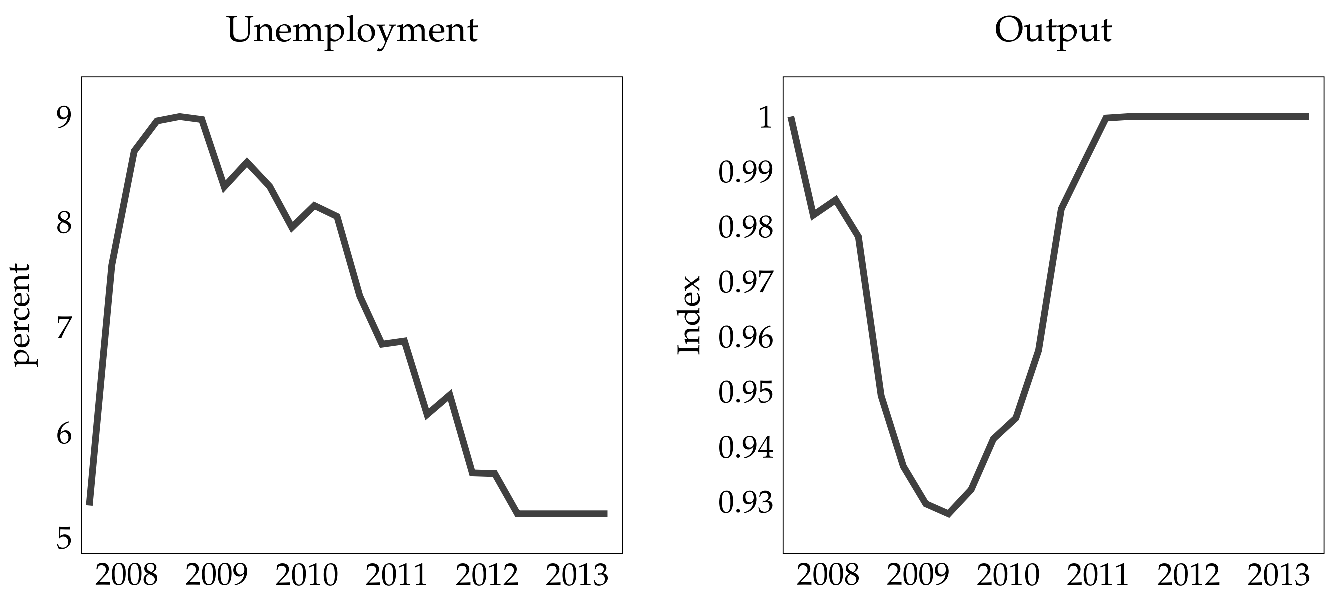

Figure 10: Targeted unemployment and output for Great Recession experiment.

Figure 11 plots the empirical[32] (solid) and model-implied (dashed) earnings dynamics for high- (blue) and low-wealth workers (red). The lines are shown relative to steady state for the model and relative to earnings in 2007:Q4 for the data. The model does a good job at matching the empirical dynamics in earnings by wealth even without directly targeting earnings.

The question now is how much of the model-implied earnings gap is due to the novel forces in my model? The answer is that 42 percent of the empirical earnings gap can be explained by the novel features of my model. To arrive to this number I compare the benchmark model to the naïve model introduced earlier. This is shown in Figure 12 which plots the earning gaps, whereas Figure 11 plots the level dynamics for low- and high-wealth workers separately. In the solid black is the empirical earnings gap, in the dashed orange is the earnings gap implied by the benchmark model, and in dotted green

[32]Earnings are de-trended using the Hamilton filter and kept constant once the new cycle begins.

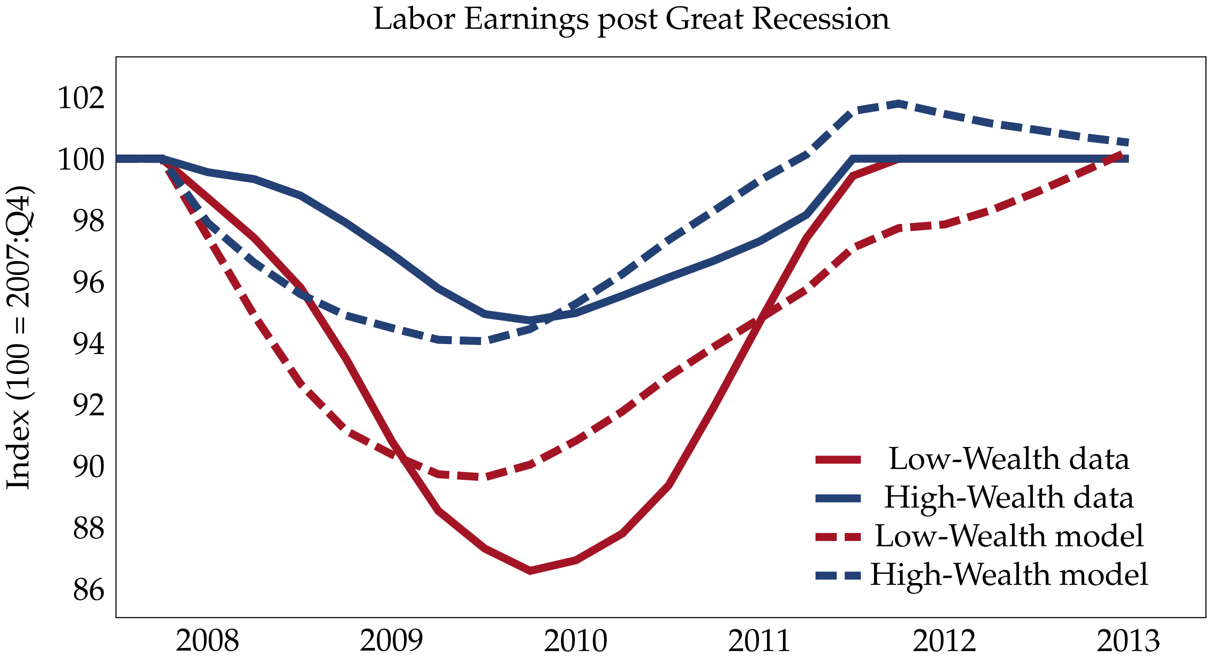

Figure 11: Great Recession earnings dynamics for low- (red) and high-wealth (blue) workers in the data (solid) and the model (dashed).

is the earnings gap implied by the naïve model. The area between the green dotted and orange dashed lines indicates how much of the earnings gap the novel mechanisms of my model can explain. This area corresponds to 42 percent of the empirical earnings gap.

I further decompose the share of the earnings gap explained by the model in the contributions of precautionary job-keeping and the tenure-wealth correlation. To do so I run a variant of the benchmark model that suppresses the precautionary job-keeping motive. This version of the model differs from the benchmark model because when solving workers' optimization, I "fool" them into thinking the job-loss probability is constant in tenure. In other words, the workers in this economy switch according to the job-switching policy functions of the naïve model but, the rest of the model dynamics, including the updating of workers along the distribution, uses the parameters from the benchmark model. This allows me to suppress the precautionary job-keeping motive while preserving the tenure-wealth correlation. Precautionary job-keeping explains 26% of the empirical earnings gap (purple shaded area) while the tenure-wealth correlation explains 18%.

Overall, the precautionary job-keeping and tenure-wealth correlation can account for roughly 42% of the earnings gap between low- and high-wealth workers observed following the Great Recession. Interestingly, the contribution of the tenure-wealth correlation is most evident at the beginning of the recession while precautionary job-keeping is more dominant in the recovery period.

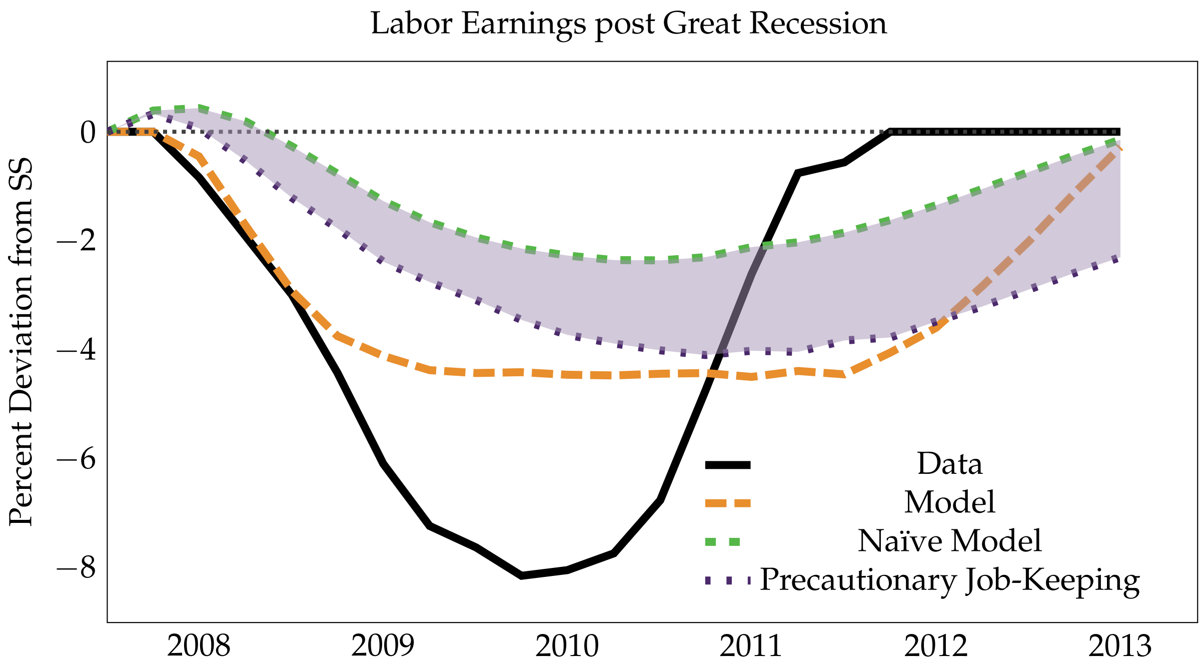

Figure 12: Great Recession earnings gap in the data (solid black), in the benchmark model (dashed orange), in the naïve model (dotted green), and the component due to precautionary job-keeping (purple shaded).

7.2 Great Resignation

The US economy behaved very differently following the Pandemic Recession than it did following the Great Recession. While the model I develop in this paper is not crafted to speak to the exceptional behavior of the US economy during the Pandemic, it can still shed light on what was behind the unusual behavior of job-switching in this period. Unlike after the Great Recession in which the aggregate job-switching rate stagnated and took years to recover, the recovery to the Pandemic Recession saw a relatively small fall followed by a fast recovery in the job-switching rate which actually jumped above pre-recession levels. This behavior was so noteworthy it is referred to as the *Great Resignation*.[33]

One of the main factors that sets the Pandemic apart from previous recessions is the size of the fiscal response. According to the IMF,[34] the three main fiscal stimulus bills passed by Congress, the CARES act, the CAA, and the ARP injected roughly 20% of GDP into the economy in the form of direct transfers, extended and increased unemployment

[33]This term, used in the popular press as well as among the academy, refers to quits broadly: quits into retirement, quits into non-participation, and, what the discussion here is concerned with, quits into new employment.

[34]See https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

benefits, help to businesses, aid to state and local governments, and more. One of the effects of this stimulus is that, except for an initial drop, wealth actually grew during and following the recession, especially at the bottom of the wealth distribution. This is shown in figure 13 which compares the evolution of net-worth by wealth percentile. Unlike the 2001 and 2007-09 recessions which saw wealth fall, especially at the bottom of the wealth distribution, the Pandemic recession saw rapid increases in wealth especially for low-wealth workers.

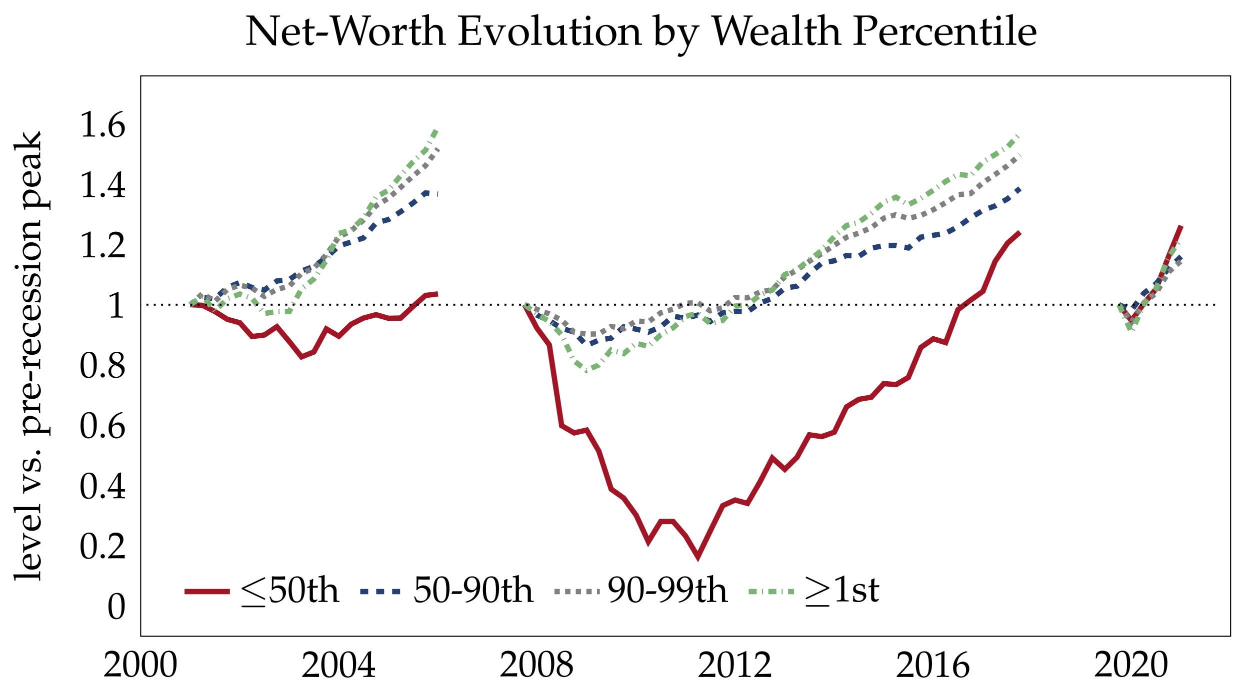

Figure 13: Evolution of net worth from pre-recession peak by wealth percentiles. Source: Distributional Financial Accounts, Board of the Federal Reserve System.

What does this imply for the precautionary job-keeping motive? Higher wealth should relax precautionary job-keeping and increase the willingness of workers to switch jobs. I test my model vis-à-vis the data by subjecting the calibrated model to two shocks to mimic the fiscal response during the pandemic. The first shock is to government transfers. While transfers are calibrated to be 0 in steady state, I subject the economy to a positive transfers shock for eight quarters that cumulates to 3.9% of output, equivalent to what the CARES, CAA, and ARP acts allocated to direct payments. The second shock is to unemployment benefit. Once again, I subject the economy to a four quarter increase in unemployment insurance that cumulates to 2.7% of output, the amount allocated by the three programs to either extra or extended unemployment benefits. Figure 14 shows what the model implies about the evolution of the job-switching rate after the Pandemic in various counterfactual scenarios.

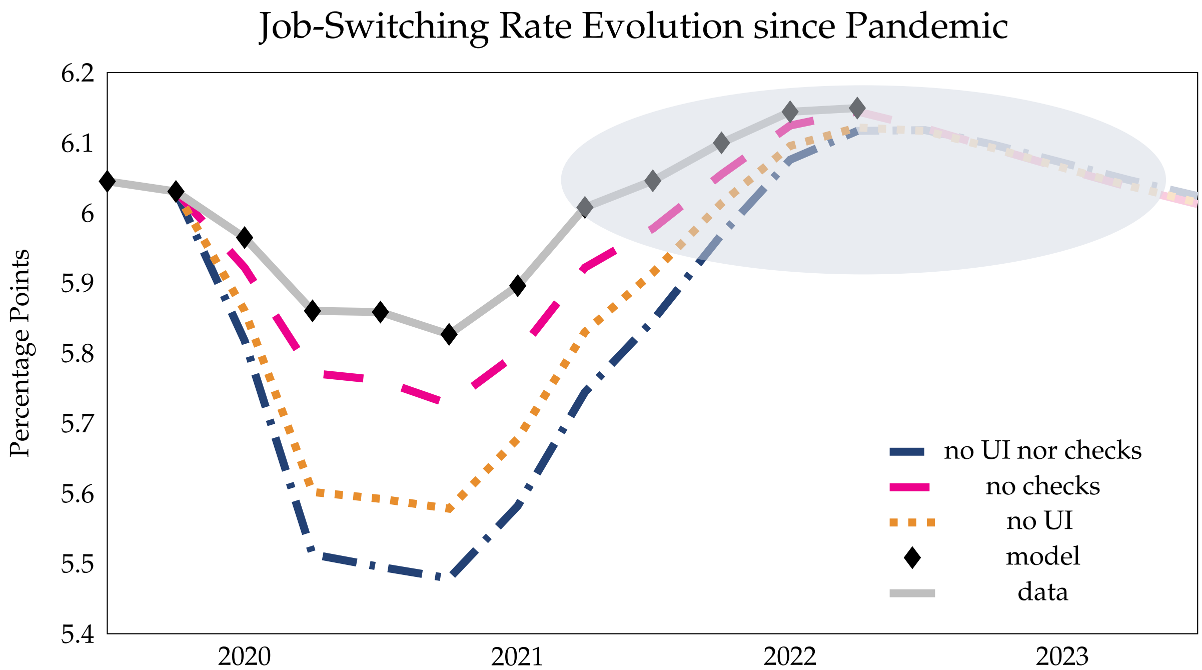

Figure 14: Evolution of the job-switching rate post-Pandemic. The data (and model shocked to mimic the data) are in gray. Three counterfactual scenarios varying the generosity in fiscal transfers are shown in the dashed, dotted, and dash-dotted lines.

The solid gray line shows the evolution of the job-switching rate in the data as well as in the model (black diamonds) subject to the transfer and unemployment benefits shocks discussed above as well as a series of shocks to the common job-loss probability σ, selected so that the model exactly matches the data counterpart.[35] The other lines in figure 14 show the recovery in the job-switching rate in three counterfactual scenarios. In all of these scenarios the economy is subject to the same productivity shocks as the economy depicted in the gray line but the fiscal transfers vary. The dashed magenta line shows what the evolution of the job-switching rate would have been without additional unemployment benefits but maintaining the direct payments. The dotted orange line shows the flip of that: agents received only extra unemployment benefits but no direct payments. Finally, the blue dash-dotted line shows how the job-switching rate would have evolved if no direct payments nor extra unemployment benefits had been issued.

Figure 14 makes clear that government stimulus had a large role to play in the evo-

[35]Note, because the SIPP does not reach this far I use the change in the job-to-job transition rate estimated in Fujita, Moscarini and Postel-Vinay (2020) applied, at a quarterly frequency starting from 2019:Q4. One potential objection is that their estimates are based on the CPS while my steady state estimate is based on SIPP.

lution of the job-switching rate following the Pandemic. The fiscal injection put money in worker's pockets, especially at the bottom of the wealth distribution. This alleviated the precautionary job-keeping motive and helped sustain the recovery in job-to-job transitions.

8 Conclusion

In this paper I ask why workers with different wealth experience such different recoveries in their earnings following economic downturns. This earnings gap, which I document to have been particularly large during the Great Recession, implies that low-wealth workers, who are those worse equipped to confront downturns, are also those hit hardest by them.

To answer this question, I build a macro model of the labor market with three key ingredients: curved utility, incomplete markets and asset accumulation, and risky job moves. Risky job moves arise because tenure at the job determines the worker's layoff probability. This leads worker who switch jobs, moving from higher to no tenure, to suffer an increase in their job-loss probability. I document this additional job-loss probability to be economically significant: a 6.4 percentage point increase in the probability of job-loss over the first fifteen months at the new job. In order to solve the model I apply an alternating offer bargaining protocol to a new environment for on-the-job search, one with concave utility and asset accumulation. The model delivers two forces linking workers' job-switching and job-losing behavior to wealth. Wealth is tied to job-switching through the phenomenon I denote *precautionary job-keeping* and to job-losing through the *tenure-wealth correlation*.

These mechanisms allow the model to make sense of the cyclical distributional variation in the job-switching and job-losing behavior of workers across wealth and help the model explain roughly 42 percent of the earnings gap experienced after the Great Recession between low- and high-wealth workers. In addition, the model provides one possible rationalization of the Great Resignation, the fast recovery and ultimate spike in job-switching observed following the Pandemic. The model implies that the generous fiscal stimulus that accompanied the recession sustained job-switching and facilitated the Great Resignation.

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A Appendix: Model

A.1 Job Market Flows with On-the-Job Search

Because the model is in discrete time, the job-finding and vacancy-filling rates are probabilities rather than arrival rates. Here I define appropriate boundaries for the labor market tightness parameters so that neither the job-finding nor the job-posting probabilities are outside the interval $[0, 1]$.

1. For unemployed agents, all of whom are searching we have that the two following conditions must hold

$$\begin{aligned}
0 \leq q(\theta_1) \leq 1 \quad &\Longleftrightarrow \quad 0 \leq \chi \left(\frac{1}{\theta_1}\right)^{\eta} \leq 1 \\
\Rightarrow \quad & \quad \chi^{\frac{1}{\eta}} \leq \theta_1 < \infty \\
0 \leq \lambda(\theta_1) \leq 1 \quad &\Longleftrightarrow \quad 0 \leq \chi\theta_1 \left(\frac{1}{\theta_1}\right)^{\eta} \leq 1 \\
\Rightarrow \quad & \quad 0 \leq \theta_1 < \chi^{\frac{1}{\eta-1}}
\end{aligned}$$

   Because $\chi < 1$, it must be that

$$\theta_1 \in [\chi^{\frac{1}{\eta}}, \chi^{\frac{1}{\eta-1}}] \tag{A.1}$$

2. For employed agents, a share s of whom are searching we have that the two following conditions must hold

$$\begin{aligned}
0 \leq q(\theta_k) \leq 1 \quad &\Longleftrightarrow \quad 0 \leq \chi \left(\frac{s}{\theta_k}\right)^{\eta} \leq 1 \\
\Rightarrow \quad & \quad s\chi^{\frac{1}{\eta}} \leq \theta_k < \infty \\
0 \leq \lambda(\theta_k) \leq 1 \quad &\Longleftrightarrow \quad 0 \leq \chi\theta_k \left(\frac{s}{\theta_k}\right)^{\eta} \leq 1 \\
\Rightarrow \quad & \quad 0 \leq \theta_k < (s^{\eta}\chi)^{\frac{1}{\eta-1}}
\end{aligned}$$

   Because $\chi < 1$, it must be that

$$\theta_k \in [s\chi^{\frac{1}{\eta}}, (s^{\eta}\chi)^{\frac{1}{\eta-1}}] \tag{A.2}$$

A.2 Walras' Law

I show that Walras' law holds. First aggregating the budget constraint of unemployed workers gives

$$\begin{aligned}
\int_i c_t(i) + a_{t+1}(i)\, di &= \int (1+r)a_t(i) + (1-\tau_t)b + T_t\, di \\
&\quad \text{where the integral is over unemployed agents} \\
C_t^U + A_{t+1}^U &= (1+r)A_t^U + ((1-\tau_t)b + T_t)\int di^U
\end{aligned}$$

Doing the same exercise for the employed gives

$$C_t^E + A_{t+1}^E = (1+r)A_t^E + (1-\tau_t)\int w(i^E)\, di^E + T_t \cdot \left(1 - \int di^E\right)$$

Summing the two gives

$$\begin{aligned}
\left(C_t^U + C_t^E\right) + \left(A_{t+1}^U + A_{t+1}^E\right) &= (1+r_t)\left(A_t^U + A_t^E\right) + T_t \\
&\quad +(1-\tau_t)b \cdot \int di^U + (1-\tau_t)\int w(i^E)\, di^E \\
C_t + A_{t+1} &= (1+r_t)A_t + \int w(i^E)\, di^E \\
&\quad +T_t + (1-\tau_t)b\int di^U - \tau_t \int w(i^E)\, di^E \\
&\quad \text{using the balanced budget equation} \\
C_t + A_{t+1} &= (1+r_t)A_t + \int w(i^E)\, di^E + \Pi_t
\end{aligned}$$

Recall also that the flow of profits of an individual firm is simply

$$\pi = (p_k \cdot \epsilon)\left[f(k) - r^K k\right] - w$$

which, aggregating over all firms and netting out the total vacancy costs gives

$$\Pi_t = \int \left(p_k \cdot \epsilon(i^E)\right)\left[f(k) - r^K k\right] - w(i^E)\, di^E - \xi \cdot \sum_{k=1}^{K} v = Y_t - \int \left(p_k \cdot \epsilon(i^E)\right) r^K k + w(i^E)\, di^E - \xi \cdot \sum_{k=1}^{K} v$$

Including this in the equation above gives

$$C_t + A_{t+1} = (1+r_t)A_t + \int w(i^E)\, di^E + Y_t - \int \left(p_k \cdot \epsilon(i^E)\right) r^K k + w(i^E)\, di^E - \xi \cdot \sum_{k=1}^{K} v$$

$$C_t = Y_t + ((1+r_t)A_t - A_{t+1}) - r^K K_t - \xi \cdot \sum_{k=1}^{K} v$$

Note, asset market clearing implies that $p_t(K_t) = A_t$ and $p_{t+1}(K_{t+1}) = A_{t+1}$, and thus we can rewrite this expression as

$$\begin{aligned} C_t &= Y_t + \underbrace{(1+r_t)\, p_t(K_t) - p_{t+1}(K_{t+1})}_{D_t} - r^K K_t - \xi \cdot \sum_{k=1}^{K} v \\ &= Y_t + \underbrace{(1+r_t)\, p_t(K_t) - p_{t+1}(K_{t+1})}_{D_t} - r^K K_t - \xi \cdot \sum_{k=1}^{K} v \end{aligned}$$

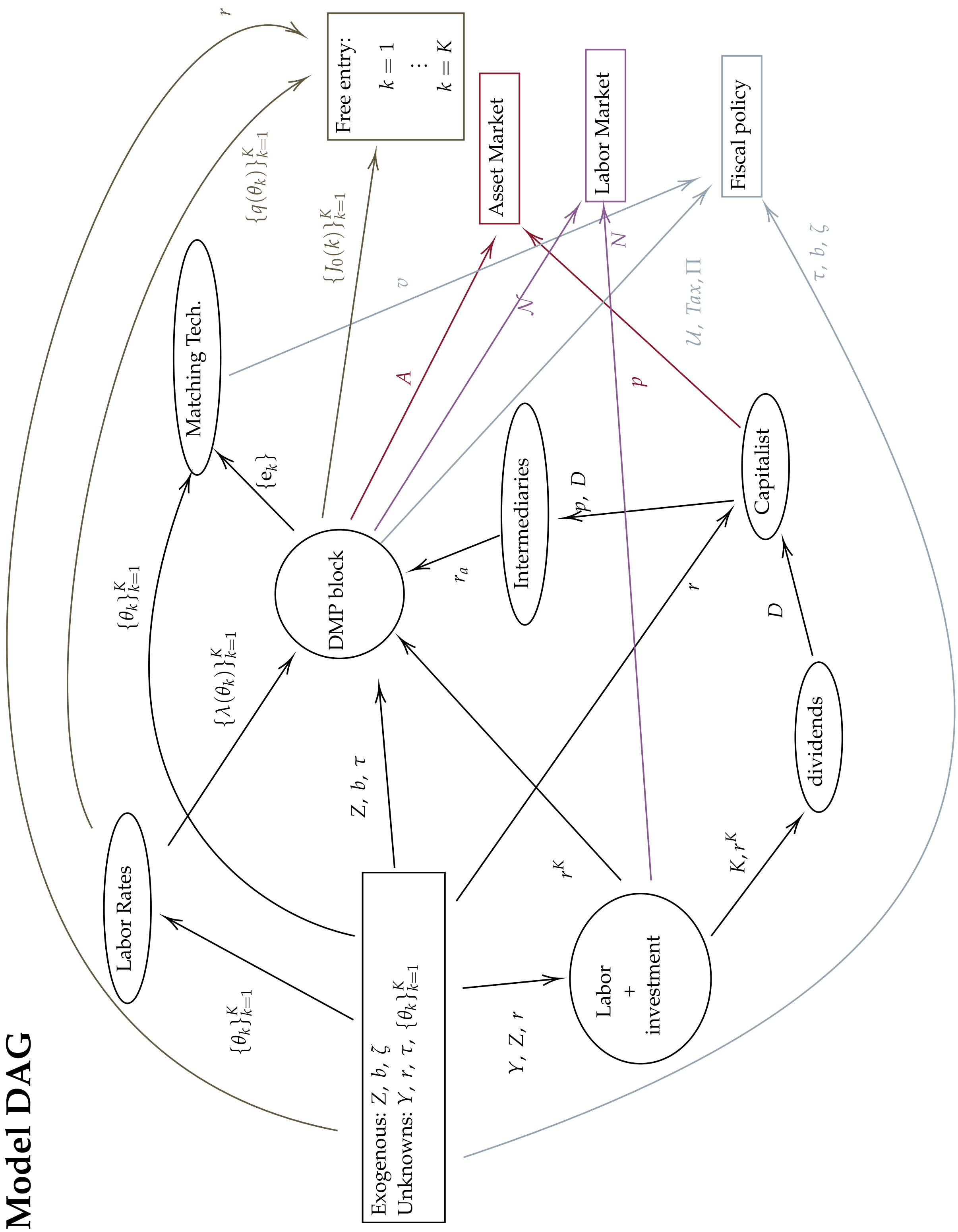
Substituting the definition of dividends from 11 gives

$$\begin{aligned} C_t &= Y_t + r_t^K K_t - \left[K_{t+1} - (1-\delta) K_t + \frac{1}{2\delta\epsilon_I} \left(\frac{K_{t+1} - K_t}{K_t} \right)^2 K_t \right] - r^K K_t - \xi \cdot \sum_{k=1}^{K} v \\ C_t &= Y_t - \left[K_{t+1} - (1-\delta) K_t + \frac{1}{2\delta\epsilon_I} \left(\frac{K_{t+1} - K_t}{K_t} \right)^2 K_t \right] - \xi \cdot \sum_{k=1}^{K} v \qquad \text{(A.3)} \end{aligned}$$

that is, consumption equals output minus investment and capital adjustment costs. In steady state this boils down to the economy-wide resource constraint

$$C = Y - \delta K - \xi \cdot \sum_{k=1}^{K} v$$

A.3 Model DAG and Blocks



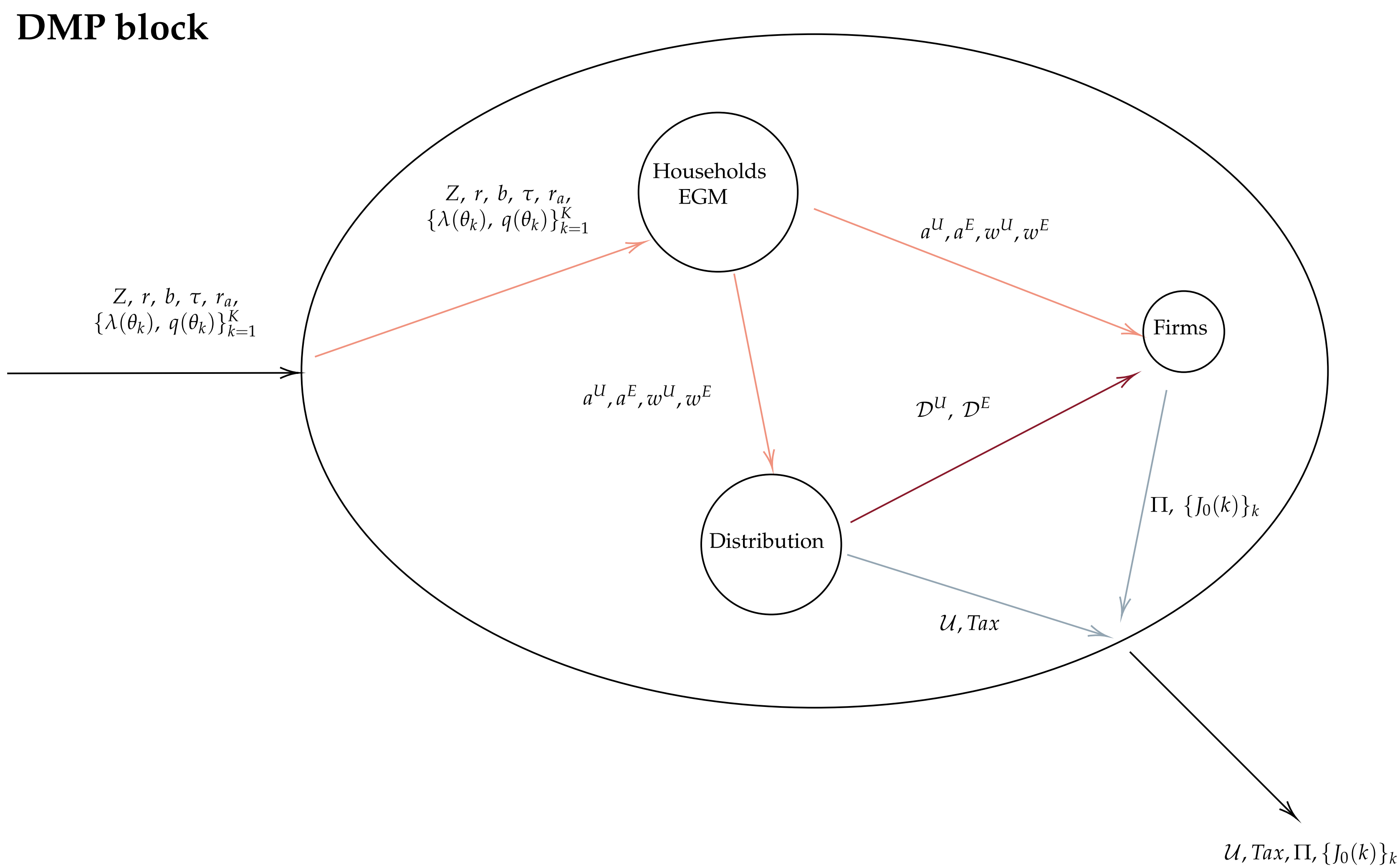


Figure 16: Model DAG.

Labor flow rates. Vacancies opened today result in matches tomorrow. The job-finding and vacancy-filling rates are then

$$
\begin{aligned}
q_t(0) &= \chi\left(\frac{1}{\theta_{t-1}(0)}\right)^{\eta} && \text{(A.4)}\\
\lambda_t(0) &= \theta_{t-1}(0)\cdot q_t(0) && \text{(A.5)}\\
q_t(k) &= \chi\left(\frac{s}{\theta_{t-1}(k)}\right)^{\eta} && \text{(A.6)}\\
\lambda_t(k) &= \theta_{t-1}(k)\cdot q_t(k) && \text{(A.7)}
\end{aligned}
$$

Matching Technology. Computes the vacancies posted by firms at time t given the mass of searchers on each rung, $e_t(k)$

$$v_t(k) = \theta_t(k)\cdot e_t(k) \tag{A.8}$$

Labor + Investment (solved). For labor the standard CRS equation holds:

$$
\begin{aligned}
L_t &= \left(\frac{Y_t}{Z_t K_{t-1}^{\alpha}}\right)^{\frac{1}{1-\alpha}} && \text{(A.9)}\\
r_t^K &= \alpha Z_t\left(\frac{L_t}{K_{t-1}}\right)^{1-\alpha} && \text{(A.10)}
\end{aligned}
$$

and for investment

$$
\begin{aligned}
Q_t &= \frac{1}{\delta\epsilon_I}\left(\frac{K_t}{K_{t-1}}-1\right)+1 && \text{(A.11)}\\
Q_t &= \frac{1}{1+r_t}\mathbb{E}\left[r_{t+1}^K-\frac{K_{t+1}}{K_t}+(1-\delta)-\frac{1}{2\delta\epsilon_I}\left(\frac{K_{t+1}}{K_t}-1\right)^2+\frac{K_{t+1}}{K_t}Q_{t+1}\right] && \text{(A.12)}
\end{aligned}
$$

Dividend. The dividend spits out investment and the dividend

$$
\begin{aligned}
\phi(K_t,K_{t-1}) &= K_{t-1}\cdot\frac{1}{2\delta\epsilon_I}\left(\frac{K_t}{K_{t-1}}-1\right)^2 && \text{(A.13)}\\
I_t &= K_t-(1-\delta)K_{t-1}+\phi(K_t,K_{t-1}) && \text{(A.14)}\\
D_t &= r_t^K K_{t-1}-I_t && \text{(A.15)}
\end{aligned}
$$

Capitalist. The dividend is priced such that the (ex-ante) real interest rate is

$$1 + r_t \;=\; \frac{\mathbb{E}\left[p_{t+1} + D_{t+1}\right]}{p_t} \tag{A.16}$$

Intermediaries. The intermediary blocks sets the deposit rate (that HH take)

$$1 + r_t^a \;=\; \frac{D_t + p_t}{p_{t-1}} \tag{A.17}$$

Objectives. And the objective functions are

$$A \;=\; p \tag{A.18}$$

$$N \;=\; L \tag{A.19}$$

$$Tax_t + \Pi_t - \zeta\left(\sum_{k=0}^{K} v_t(k)p(k)\right) \;=\; (1-\tau_t)UI_t + T_t \tag{A.20}$$

A.4 Micro-founding the Job-Loss Probability

A job-loss probability that is decreasing in tenure can be microfounded differently from the way I do in the body of the paper. Here I including learning on the job about the quality of the match between worker and firm in the spirit of Jovanovic (1979). I develop the problem following Pries and Rogerson (2005).

Setup. The quality of the firm-worker match $\bar{y}$ is not observable, rather the firm observes a noisy version of it

$$y \;=\; \bar{y} \cdot \omega \tag{A.21}$$

where ω is noise. The true match-quality can be high, y_H, or low, y_L, with unconditional probabilities π^0 and $1 - \pi^0$, respectively.

For simplicity, assume the true match quality is revealed at $j = J$, that is, after the match persists long-enough, there is no more uncertainty about its quality. Before it, however, $\omega \neq 0$ is distributed according to a mean zero probability mass function $h(\omega)$ with support $[\underline{\omega}, \overline{\omega}]$ (where $H(\omega)$ is the cdf).

Separation Rate. The match is dissolved whenever the firm prefers its outside option to sticking to the worker. I consider here a worker who previously agreed on a wage w with the firm. Worker and firm values depend on the other states of the problem (e.g. assets) but I suppress them in the following notation for convenience and simply write the firm's value as a function of output and the wage paid, $J(\bar{y}, w)$.

If the realized output y is very low, the firm will think the worker is of low quality and will opt to terminate the relationship. Thus, if the firm observes y from the worker, it will update its prior on the worker being high quality according to Bayes' rule. If π_{j-1} is the probability of the match being of high quality at tenure $j-1$, the probability at j is

$$\pi_j = \frac{\pi_{j-1} Pr(\omega = y^H - y_j)}{\pi_{j-1} Pr(\omega = y^H - y_j) + \left(1 - \pi_{j-1}\right) Pr(\omega = y^L - y_j)}$$

where y_j is the output observed at j. The value the firm expects to extract from the worker is

$$J^{\text{keep}}\left(y_j, w\right) = \left(y_j - w\right) + \frac{1}{1+r}\left[\pi_1 J\left(y^H, w\right) + (1 - \pi_1) J\left(y^L, w\right)\right]$$

while the value the firm would get by laying off the worker is

$$J^{\text{fire}}\left(y_j, w\right) = \left(y_j - w\right) + \frac{1}{1+r} V = \left(y_j - w\right)$$

where V is the value of vacancy. The firm will then fire the worker whenever $J^{\text{fire}} > J^{\text{keep}}$.

B Appendix: Details on Bargaining with Employed Agents

Proof. (Result 1)
Consider the wage making firm k indifferent between opening a vacancy and accepting the contract with the worker signed at sub-period m. This indifference is:

$$\left(\epsilon p_k \left[Zf(k) - r^K \kappa\right] - w^*\right) + \beta \mathbb{E}\left[J\left(\psi_a, \epsilon', w^*, k, j+1\right)\right] = 0$$

It is clear that there is no dependence on m and thus the solution $\overline{w}_{m,k}$ will also be independent of m. That is $\overline{w}_k := \overline{w}_{1,k} = \ldots \overline{w}_{M,k}$ and $\overline{w}_{m',k}$

Consider the same indifference condition for firm k':

$$\frac{M-m+1}{M}\left(\epsilon p_{k'} \left[Zf(k) - r^K \kappa\right] - w^*\right) = -\frac{1}{1+r}\mathbb{E}\left[J\left(\psi_a, \epsilon', w^*, k', 0\right)\right]$$

While the RHS is constant in m, the LHS shifts down as m increases and hence $\overline{w}_{m,k'} > \overline{w}_{m',k'}$ for $m' > m$ as shown in the figure below.

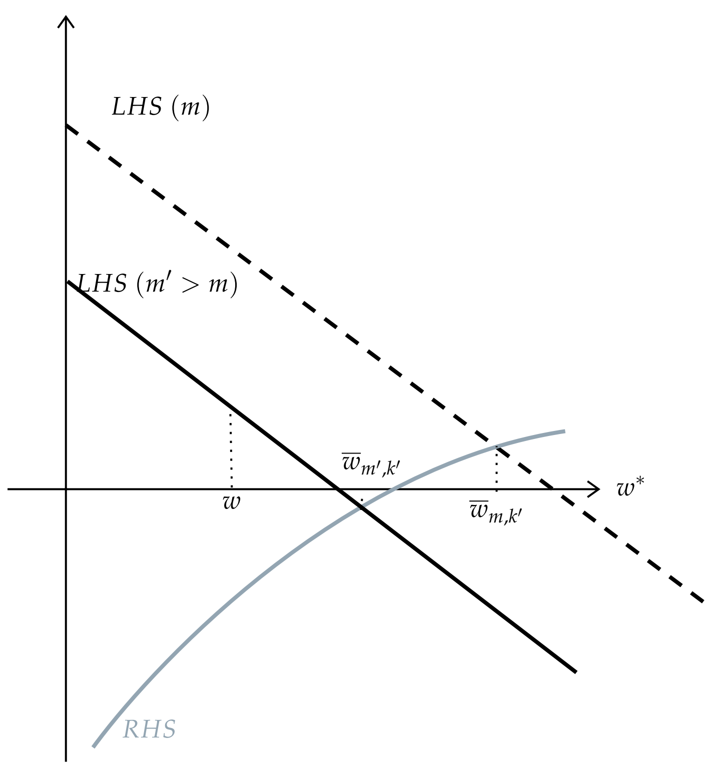


Figure 17: Lemma 1 graphic proofs.

□

Proof. (Result 2)
From Lemma 1 and the terminal values for the worker defined in 24, it follows immediately that $V_1^k(\overline{w}_{1,k}) = \dots V_M^k(\overline{w}_{M,k})$. From Result 1 and the terminal values for the worker defined in 26, it follows immediately that $V_1^{k'}(\overline{w}_{1,k'}) > \cdots > V_M^{k'}(\overline{w}_{M,k'})$. □

Strategies. When m is odd, the firms bid for the worker in a sealed bid first price auction. There is complete information and firms know each others' valuations of the worker as well as the outside option of the worker, that is the value the worker receives at $m+1$ if no agreement is reached at m. These valuations are $\overline{V}^k$ for firm k (recall there is no dependence on m) and $\overline{V}_m^{k'}$ for firm k'. Denote the value the worker receives at $m+1$ as V^{out} – this is $V^k(w)$ if $m = M$ as the bargaining breaks down and the worker returns to firm k at the original wage. Four possibilities arise:

1) If $\overline{V}^k > V^{\text{out}} \geq \overline{V}_m^{k'}$, the maximal offer firm k' can make does not compete with the value the worker receives in the following sub-period. Because the worker can always wait until the next period and earn value V^{out}, no offer $V < V^{\text{out}}$ can be accepted in equilibrium. Firm k' will offer the best it can, $\overline{V}_m^{k'}$ with no hope of poaching the worker, and firm k will offer the minimum value to retain the worker, that is $\max\{V^{\text{out}}, \overline{V}_m^{k'}\} = V^{\text{out}}$. The worker, indifferent between accepting and moving on to the next period, accepts the offer firm k makes and is retained by firm k at the wage w^* satisfying $V^k(w^*) = V^{\text{out}}$.
2) If $\overline{V}^k \geq \overline{V}_m^{k'} > V^{\text{out}}$, no offer $V < \overline{V}_m^{k'}$ is made in equilibrium, since both firms k and k' can do better. Firm k offers all it can, $\overline{V}_m^{k'}$. Firm k matches that offer (and offers an infinitesimal more in value) to retain the worker at wage w^* satisfying $V^k(w^*) = \overline{V}_m^{k'}$.
3) If $\overline{V}_m^{k'} > \overline{V}^k > V^{\text{out}}$, no offer $V < \overline{V}^k$ is made in equilibrium since both firms k and k' can do better. Firm k offers all it can, $\overline{V}^k$. Firm k' matches that offer (and offers an infinitesimal more in value) to poach the worker at wage w^* satisfying $V_m^{k'}(w^*) = \overline{V}^k$.
4) If $\overline{V}_m^{k'} \geq V^{\text{out}} > \overline{V}^k$, no offer $V < V^{\text{out}}$ is made in equilibrium, otherwise the worker would prefer waiting until $m+1$. Firm k offers all it can, $\overline{V}^k$ but has no hope of retaining the worker. Firm k' offers the bare minimum in order to hire the worker, that is $\max\{V^{\text{out}}, \overline{V}^k\} = V^{\text{out}}$. k' poaches the worker at wage w^* satisfying $V_m^{k'}(w^*) = V^{\text{out}}$.

When m is even, the worker starts by making an offer to firm k'. It proposes a wage that makes k' indifferent between accepting the offer and waiting until the next sub-period. The following cases arise:

1) Suppose $\overline{V}^k > V^{\text{out}} \geq \overline{V}_m^{k'}$. In this case the worker first makes an offer to worker k' making it indifferent between accepting the wage and waiting until sub-period $m+1$. Result 2 implies that $\overline{V}^k > V^{\text{out}} \geq \overline{V}_m^{k'} > V_{m+}^{k'}\left(\overline{w}_{m+}^{k'}\right)$. The strategies at $m+1$ imply firm k' will not be able to poach the worker in the next sub-period and will in fact remain vacant. The worker then extract all the match value from k' by offering $\overline{w}_m^{k'}$ and k' accepts. The worker asks firm k to match her best available offer which is $\max\{V^{\text{out}}, V_{m+}^{k'}\left(\overline{w}_{m+}^{k'}\right)\} = V^{\text{out}}$. Thus, firm k retains the worker at wage w^* satisfying $V^k\left(w^*\right) = V^{\text{out}}$.

2) Suppose $\overline{V}^k \geq \overline{V}_m^{k'} > V^{\text{out}}$. Just as before the worker is able to extract the entirety of the value from firm k' by proposing wage $\overline{w}_m^{k'}$ as k' will remain vacant at $m+1$ if no agreement is reached at m (by result 2). The worker then asks firm k to match the best outside offer the worker has, that is $\max\{V^{\text{out}}, \overline{V}_m^{k'}\} = \overline{V}_m^{k'}$. Firm k will match $\overline{V}_m^{k'}$ in order to avoid having firm k' poach the worker. The new wage firm k and the worker agree on is w^* satisfying $V^k\left(w^*\right) = \overline{V}_m^{k'}$.

3) Suppose $\overline{V}_m^{k'} > \overline{V}^k \geq V^{\text{out}} \geq \overline{V}_{m+1}^{k'}$, then at $m+1$ firm k is able to provide the worker more value than firm k'. This is the case because, if the value the worker gets at $m+1$ is $V^{\text{out}} \geq \overline{V}_{m+1}^{k'}$, this value can only be delivered by firm k as firm k' would prefer posting a vacancy than providing the worker with such high a value[36]. This means that at m, the outside option of firm k' is to post a vacancy. The worker can then extract all the value from firm k' by proposing wage $\overline{w}_m^{k'}$. Firm k will fail to match this offer since the maximal value it can offer the worker is lower than $\overline{V}_m^{k'}$. The worker is poached by firm k' at wage $\overline{w}_m^{k'}$.

4) Suppose $\overline{V}_m^{k'} > \overline{V}_{m+1}^{k'} > V^{\text{out}} \geq \overline{V}^k$, then at $m+1$ firm k' would still retain the worker as per the strategies described above[37]. The worker then offers a wage w_m^* making the firm indifferent between accepting and moving on to the next sub-period, that is $\frac{M-m+1}{M} y_{k'} + \frac{1}{1+r}\mathbb{E}\left[J^{k'}\left(w_m^*\right)\right] = J_m^{k'}\left(w_{m+1}^*\right)$.

Note that in case 4. firm k is irrelevant. How then is the outside option of firm k' determined? The worker and firm k' alternate making offers that make the other party indifferent between accepting and waiting until the next sub-period, until, at some m^*

[36] In fact, it can be shown that in this scenario $V^{\text{out}} = \overline{V}^k$

[37] It can be shown that $V^{\text{out}} \geq \overline{V}^k$, otherwise firm k would be able to offer $\overline{w}^k$ to the worker and dominate the outside offer which would in itself imply V^{out} is not the outside offer.

firm k' cannot count on retaining the worker at m^*+1. This occurs when $V_m^{k'}\left(\overline{w}_{m^*}^{k'}\right) > \overline{V}^k \geq V^{\text{out}} \geq V_{m^*+1}^{k'}\left(\overline{w}_{m^*+1}^{k'}\right)$. At this m^* the strategy is exactly as described in case 3) for both m odd or even. Firm k' poaches the worker but must match the total value k can offer the worker. In the previous sub-periods $m < m^*$ firm k' and the worker negotiate bilaterally knowing what will happen at m^*.[38]

Example with $M = 3$. Consider the case with $M = 3$. I solve the problem backwards and compute the possible scenarios reflected in 4.

$m = 3$ It is the firms' turn to make offers through a sealed-bid first-price auction. If the worker accepts neither of the offers made, she will stick to the old firm k at the original wage w. The value from doing so is $V(w)$. The firms offer values according to 27 and 28 rewritten below with $V^{\text{out}} = V(w)$ for convenience:

$$\begin{aligned} V_3^{k,\text{bid}} &= \min\left\{\max\left\{V(w), \overline{V}_3^{k'}\right\}, \overline{V}^k\right\} \\ V_3^{k',\text{bid}} &= \min\left\{\max\left\{V(w), \overline{V}^{k}\right\}, \overline{V}_3^{k'}\right\} = \min\left\{\overline{V}^k, \overline{V}_3^{k'}\right\} \end{aligned}$$

Notice that at $m = M$, the worker's waiting option $V^{\text{out}} = V(w)$ and so the inner maximization when k' bids is always equal to the valuation of the worker by firm k, $\overline{V}^k$. The following cases arise:

(a) if $V(w) \geq \overline{V}_3^{k'}$, that is the current contract's value is greater than what the new firm k' can deliver, it must also be that $\overline{V}^k > V(w) \geq \overline{V}_3^{k'}$. This results in bids:

$$V_3^{k,\text{bid}} = V(w) \quad > \quad V_3^{k',\text{bid}} = \overline{V}_3^{k'}$$

Firm k retains the worker at wage w.

(b) if $\overline{V}^k \geq \overline{V}_3^{k'} > V(w)$ the old firm still has a higher valuation for the worker but the new firm's valuation is higher than the current contract. Here a renegotiation is in order. The bids will result in

$$V_3^{k,\text{bid}} = \overline{V}_3^{k'} \quad \geq \quad V_3^{k',\text{bid}} = \overline{V}_3^{k'}$$

The worker stays at the old firm but re-negotiates a higher wage delivering her the valuation the new firm k' had for the worker.

(c) if $\overline{V}_3^{k'} > \overline{V}^k > V(w)$ the old firm has a higher valuation for the worker. The

[38] If no such m^* exists, $m^* = M$ and the firm offers the worker exactly what firm k is able to offer.

bids will be

$$V_3^{k,\text{bid}} = V_3^k\left(\overline{w}^k\right) \quad < \quad V_3^{k',\text{bid}} = \overline{V}^k(+\epsilon)$$

The worker moves to the new firm at wage w_3^* delivering her the valuation the old firm k had for the worker, that is satisfying

$$V_3^{k'}\left(w_3^*\right) = \overline{V}^k \tag{A.22}$$

$m = 2$ It is the worker's turn to make the offer to the firms. It tries to extract all it can from firm k'. Depending on the scenarios delineated above (a-c) there are two cases:

(a-b) In these cases firm k' will be vacant at $m = 3$ and so the worker can extract all of its value by proposing the wage $\overline{w}_2^{k'}$ making firm k' indifferent between accepting and posting a vacancy. In order to retain the worker firm k must be able to offer the worker at least $\max\{V(w), \overline{V}_2^{k'}\}$. There are then three cases:

A. $V\left(\overline{w}^k\right) > V^k(w) \geq \overline{V}_2^{k'}$ in which case firm k matches the best offer the worker has. That best offer happens to be the current contract. k retains the worker at the original wage w.

B. $V\left(\overline{w}^k\right) \geq \overline{V}_2^{k'} > V^k(w)\left(> \overline{V}_3^{k'}\right)$ in which case firm k matches the offer by k' by offering wage w^* such that $V^k\left(w^*\right) = \overline{V}_2^{k'}$.

C. $\overline{V}_2^{k'} > V\left(\overline{w}^k\right)$ in which case firm k canont match the offer by k' which poaches the worker at wage $\overline{w}_2^{k'}$.

D. If scenario (c) is realized at $m = 3$, it must be that, using result 2, $\overline{V}_2^{k'} > \overline{V}_3^{k'} > \overline{V}^k$. In this case the worker cannot extract all the value from the firm because if the firm waits it will still retain the worker. The worker then offers a wage w_2^* satisfying

$$\begin{aligned}
&\frac{2}{3}\left(\epsilon p_{k'}\left[Zf(k) - r^K\kappa\right] - w_2^*\right) + \frac{1}{1+r}\mathbb{E}\left[J\left(\psi_a, \epsilon', w_2^*, k', 0\right)\right] \quad = \\
&= \frac{1}{3}\left(\epsilon p_{k'}\left[Zf(k) - r^K\kappa\right] - w_3^*\right) + \frac{1}{1+r}\mathbb{E}\left[J\left(\psi_a, \epsilon', w_3^*, k', 0\right)\right]
\end{aligned}$$

where w_3^* is defined in equation (A.22). Note $w_2^* > w_3^*$ because firm k' is eager to start working so as to not miss out on production and profits (see the 2/3 vs. 1/3 multiplying flow profits). Denote the value the worker gets in this case as $V_2^{k'}\left(w_2^*\right)$.

$m = 1$ It is again the firms' turn to bid for the worker. The same rules apply as for $m = 3$ but the outside option of the worker has changed from $V(w)$ to V^{out}. The firms offer values according to 27 and 28 rewritten below:

$$\begin{aligned} V_1^{k,\text{bid}} &= \min\left\{\max\left\{V^{\text{out}}, \overline{V}_1^{k'}\right\}, \overline{V}^k\right\} \\ V_1^{k',\text{bid}} &= \min\left\{\max\left\{V^{\text{out}}, \overline{V}^{k}\right\}, \overline{V}_1^{k'}\right\} \end{aligned}$$

Depending on the outside option the worker has there are several cases:

1. If A holds at $m = 2$, that is if $V\left(\overline{w}^k\right) > V^k(w) \geq \overline{V}_2^{k'}$, the value the worker gets by waiting until $m = 2$ is $V(w)$. Depending on whether $V_1^{k'}\left(\overline{w}_1^k\right)$ is greater or less than $V^k(w)$ there are two cases:

   α. If $V^k(w) > V_1^{k'}\left(\overline{w}_1^k\right)$ the bid values are:

   $$V_1^{k,\text{bid}} = V^k(w) \qquad \text{and} \qquad V_1^{k',\text{bid}} = \overline{V}_1^{k'}$$

   The worker is retained by k at the original wage w.

   β. If $V_1^{k'}\left(\overline{w}_1^k\right) > V^k(w)$ the bid values are

   $$V_1^{k,\text{bid}} = V_1^{k'}(\overline{w}_1^{k'}) \qquad \text{and} \qquad V_1^{k',\text{bid}} = \overline{V}_1^{k'}$$

   The worker is still retained by the firm but at wage w^* satisfying $V^k(w^*) = \overline{V}_1^{k'}$.

2. If scenario B is realized at $m = 2$, the outside option of the worker is $\overline{V}_2^{k'}$ delivered by firm k. From case B it is know that this value is less than $\overline{V}^k$. This leads to the bid values

   $$\begin{aligned} V_1^{k,\text{bid}} &= \min\left\{\overline{V}_1^{k'}, \overline{V}^k\right\} \\ V_1^{k',\text{bid}} &= \min\left\{\overline{V}^{k}, \overline{V}_1^{k'}\right\} \end{aligned}$$

   Two cases arise depending on how the valuation firm k can provide compares to that firm k' can provide at $m = 1$:

   γ. $\overline{V}_1^{k'} > \overline{V}^k$ in which case firm k' poaches the worker offering it a wage w_1^* satisfying $V_1^{k'}(w_1^*) = \overline{V}^k$

   δ. $\overline{V}^k \geq \overline{V}_1^{k'}$ in which case firm k retains the worker offering it a wage w^*

satisfying $V^k(w^*) = \overline{V}_1^{k'}$

3. If C holds at $m = 2$, that is if $V\left(\overline{w}^k\right) < \overline{V}_2^{k'}$, the worker is able to extract all value from k' and has as outside option $V^{\text{out}} = \overline{V}_2^{k'}$. Substituting this in the bid expressions and noticing that by results 2, $\overline{V}_1^{k'} > \overline{V}_2^{k'} > \overline{V}^k$, gives

$$V_1^{k,\text{bid}} = \overline{V}^k \qquad \text{and} \qquad V_1^{k',\text{bid}} = \overline{V}_2^{k'}$$

ϵ. Because $V_1^{k',\text{bid}} = \overline{V}_2^{k'} > V_1^{k,\text{bid}} = \overline{V}^k$ the worker is poached by k' at wage $\overline{w}_2^{k'}$ proving the worker with value $\overline{V}_2^{k'}$.

4. If case D holds at $m = 2$, that is if $\overline{V}_2^{k'} > V\left(\overline{w}^k\right)$, the worker at $m = 2$ is still poached by k' at value $V_2^{k'}(w_2^*)$ where w_2^* is defined above. By result 2 $\overline{V}_1^{k'} > \overline{V}_2^{k'}$ and so the bids become

$$V_1^{k,\text{bid}} = \overline{V}^k \qquad \text{and} \qquad V_1^{k',\text{bid}} = \overline{V}_2^{k'}$$

Summing up there are four main cases:

1. $\boldsymbol{V^k(w) \geq \overline{V}_1^{k'}}$. This comprises case α above. The new firm k' cannot compete with the existing contract. This leads to no re-negotiation with the original firm k which retains the worker.
2. $\boldsymbol{\overline{V}^k \geq \overline{V}_1^{k'} > V^k(w)}$. This comprises cases β and δ above. The new firm can still not compete with the old firm but forces it to re-negotiate its wage contract since that k' can beat. The worker is retained by k which has to offer a wage delivering $\overline{V}_1^{k'}$.
3. $\boldsymbol{\overline{V}_1^{k'} > \overline{V}^k \geq \overline{V}_2^{k'}}$. This comprises case γ above. The new firm can compete with the new firm which would otherwise dominate at $m = 2$. The new firm k' offers the worker the valuation of firm k, that is a wage that delivers the worker value $\overline{V}^k$.
4. $\boldsymbol{\overline{V}_1^{k'} > \overline{V}_2^{k'} > \overline{V}^k}$. This comprises case ϵ. The new firm's valuation of the worker is considerably higher than the valuation of the original firm. Simply providing the worker with the valuation of the old firm is not an option because the worker would then be better off waiting until $m = 2$ and threatening the new firm with a vacancy. In order to avoid this firm k' offers the worker value $\overline{V}_2^{k'}$.

This last case is the only one that grows more complicated as M increases. In that case the outside option is determined backwards starting from the first sub-period in which the valuations of the two firms cross.

C Appendix: Data

C.1 Residualized Moments

The labor income recoveries and job-flow moments residualized by a polynomial in age, sex, race, work type (union, private, govt.), and education fixed effects are shown in figure 18 and table 5, respectively.

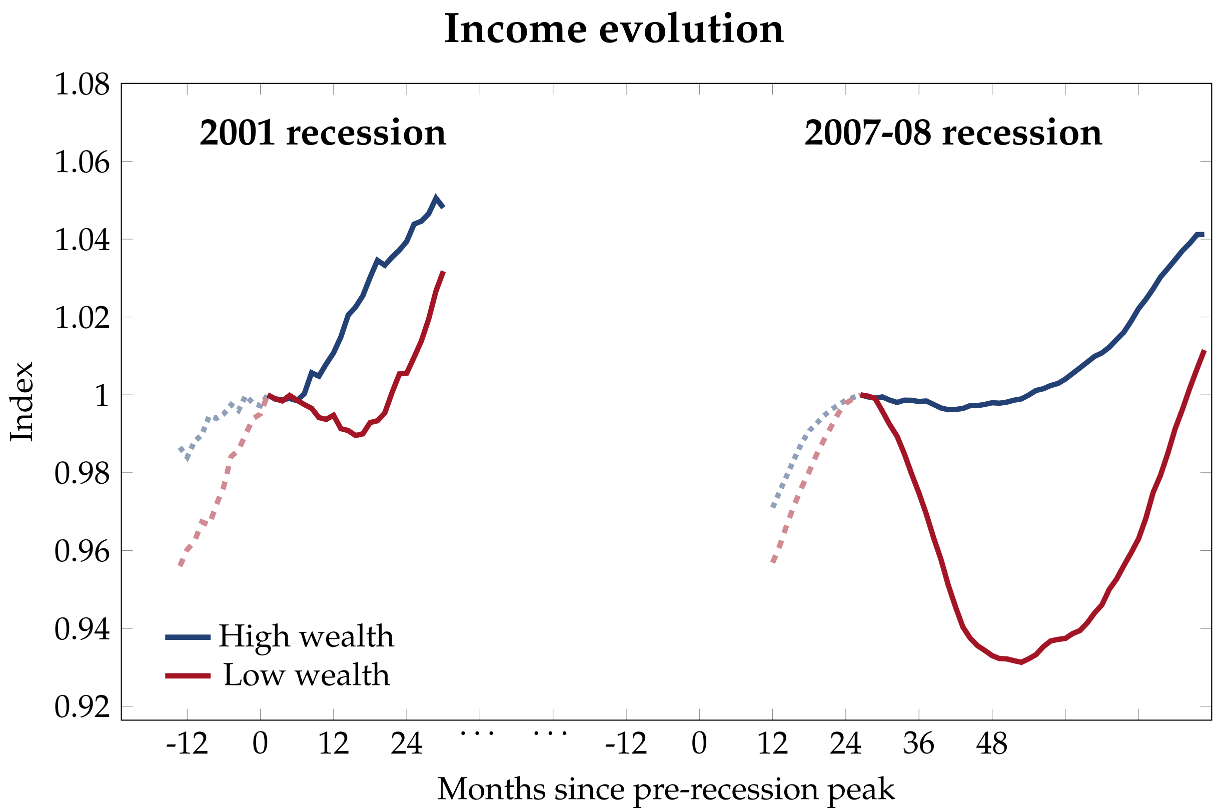


Figure 18: Labor income evolution around recessions, indexed at pre-recession peak. Top half (high-wealth) and bottom half (low-wealth) of net worth distribution excluding housing. Soure SIPP.

The estimate of θ_k's restricting to low-wealth workers only is shown in figure 19.

	Stdv.			Half-life		
	all	low-wealth	high-wealth	all	low-wealth	high-wealth
UE	4.71 (0.784)	4.52 (0.707)	5.04 (0.770)	0.9540	0.9469	0.9530
EU	0.64 (0.092)	0.79 (0.098)	0.45 (0.042)	0.8212	0.7753	0.7946
EE	1.84 (0.248)	3.10 (0.503)	1.35 (0.243)	0.8511	0.8520	0.8191

Table 5: Quarterly labor market flow rates across the distribution of net worth excluding housing residualized by polynomial in age, race, sex, industry FE, and education FE. "All" is entire sample, "low wealth" and "high wealth" are the bottom and top halves of the net worth ex. housing distribution. Standard deviations and half-lives are computed on the Hamilton-filtered rates. All data are computed using SIPP 1996-2013.

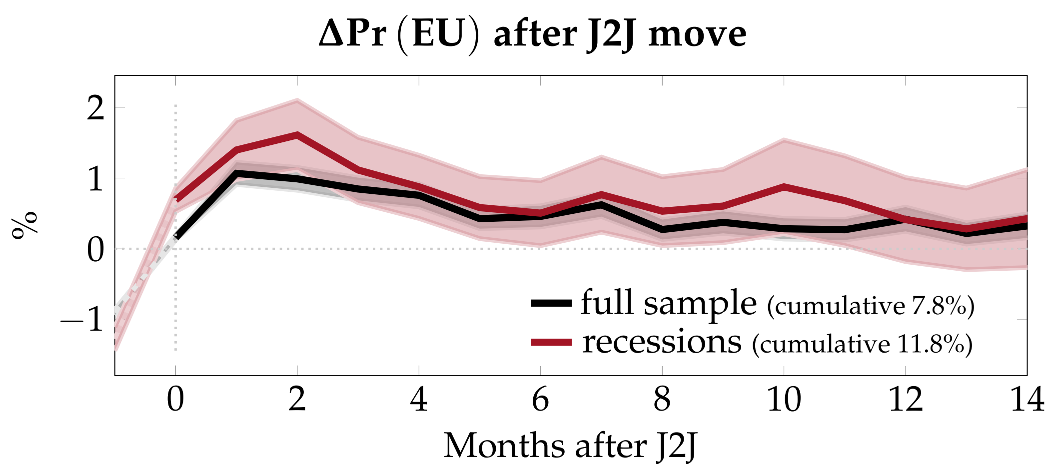


Figure 19: Change in probability of separation into unemployment after a J2J transitions. Estimated using SIPP, following (31) when restricting job switchers to those that see a strict wage increase and restricting the sample to those who fall in the bottom half of the wealth distribution.